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INCANDESCENT LAMP LITIGATION.

ELECTRIC lighting is just now in what may be termed the transition period of its history as far as the opinion of the public is concerned. For a long time it has been looked at askance, and people, whilst admiring it where successfully shown, have shaken their heads and looked fearful when its adoption has been definitely proposed. But that state of things is rapidly passing away, and confidence is replacing former doubts and uncertainties. This being the case, it would seem a wise policy for those who are directly concerned in its progress, the manufacturers of lamps and of the many appurtenances thereto, to abandon petty bickerings and jealousies, and turn their whole attention to aiding the onward flow of the flood which should bear them to fortune. That all have not recognised the wisdom of this course, or at least have not acted as if they did, our columns have borne witness during the past twelve months. As we have from time to time pointed out, electrical industries are threatened with a serious danger, and an opportunity is now offered to what is somewhat vaguely termed "the trade" to combine in opposing this danger, that they may by opposing end it. In another part of the present issue is a report of a meeting of manufacturers held at Cannon Street for the purpose of considering what action shall be taken by "the trade." A careful perusal of the report will make clear to those who were not present what is the line of conduct which should be adopted. So clear, indeed, that we do not feel called upon to do more than emphasise a few of the points which appear to us to underlie the whole object of the meeting.

It occurs to us that it was not sufficiently impressed upon the meeting that every member of the trade, even if his connection be slight, is interested in the result of this conference as certainly as are incandescent lamp makers themselves. Not long ago in commenting upon the judgment in the recently decided trial, a weekly contemporary remarked that after all lamps were but a small part of an installation. That is true in a sense; but as an argument it is difficult to imagine anything more absurd. The progress of the whole business depends entirely upon the lamps. Of what use without them are primary batteries, dynamos, secondary batteries, secondary generators, prime motors, conductors, and the thousand and one adjuncts which go to form a complete installation? Engineers—many of whom have to thank electric lighting for a large increase in their annual output of engines—dynamo constructors, wire coverers, and artistic metal workers are all concerned to a degree which is not yet fully appreciated.

The policy of the Edison-Swan Company, as far as we can gather, is to establish a monopoly similar to that at present existing in telephony, and if it is successful on appeal, one of the first consequences will be the raising of the price of lamps. Of that there is little doubt, even if nothing worse follows. What such a step will mean any firm which has framed an estimate for an electric lighting installation knows perfectly well.

A still more powerful argument for co-operation in this matter to those who wish to see electric lighting progress is the fact that Messrs. Woodhouse & Rawson have, as a result of the policy adopted by the Edison-Swan Company, taken up the Welsbach incandescent gas burner. As much as 9 candle-power per cubic foot of gas per hour can be obtained by means of this invention without extra pressure or complication of any kind, so that, if seriously pushed, it will form a formidable rival to the incandescent electric lamp, as it does not vitiate the atmosphere or destroy decorations as does gas used in the ordinary way. This is a lesson which must be taken to heart.

One proposal which was made at the meeting last week needs a little consideration. It was suggested that some four or five leading firms should take the matter of conducting the opposition to the Edison-Swan Company into their own hands. For obvious reasons it will be better that the direction of the affair should not be so confined, for it is a matter which concerns the trade generally, and in the event of the suggestion being acted upon there is a possibility that the latter may suddenly find themselves confronted with a second form of monopoly, viz., that of a "ring."

ELECTRIC RAILWAY SYSTEMS.

IN our other pages may be found a very lengthy description of the electric railway designed by Mr. F. J. Sprague, but to attempt to produce a reasonable critique thereon would necessitate the resort to innumerable quotations from the unscientific and mysterious language in which that description is couched.

So far as we can see the Sprague system consists of numerous details long since used by others—a third rail, Siemens or anybody else; double rails, block system, Ayrton and Perry; motor, an Edison (Siemens) armature "built up with alternating layers of tissue paper and very thin iron discs"; two distinct bogies for one car, the same as Reckenzaun's, except the toothed-wheel gearing; the use of the motors to produce the requisite brake power, done by Reckenzaun several years since; and so *ad infinitum*. According to the source from which we are quoting, 74 H.P. is required for each train of four cars, and Mr. Sprague proposes to transmit this power by two pinions upon each motor shaft 3·7 inches diameter, 3 inch face, and having 13 teeth; each tooth would thus have a thickness of about $\frac{3}{4}$ inch. The changes upon "characteristic," "saturation," "torque," "counter electromotive force," "potential," &c., are rung in

the most easy and accomplished manner, as if, indeed, the real meaning of these terms was not of the slightest consequence. We also read that in this system we have the first instance in which two independent motors have been simultaneously controlled from the same regulating source. Once again we have to bring Mr. Reckenzaun's name to the fore as anticipating Mr. Sprague; in fact, the system of the latter is only equalled by the "tall talk" used in explaining it. For all this we shall be pleased to learn that it is likely to become commercially successful in the States as that will probably mean emulation in this country where we have all the means at our fingers' end and yet hesitate to apply them in any other than a half-hearted manner.

ELECTRIC LIGHTING AT THE BINGLEY HALL EXHIBITION, BIRMINGHAM.

THE entire lighting of Bingley Hall by means of the electric light was entrusted to the Gülcher Electric Light and Power Company, Limited, of Battersea. The firm is locally represented by Messrs. W. and J. Player, of Lionel Street, Birmingham, and the work has been carried out to the specification and under the superintendence of Mr. Henry Lea, the consulting engineer to the British Association Committee, assisted by Mr. Mountain, manager and engineer of the Gülcher Company.

The installation, which is of considerable importance, is the largest combined arc and incandescent system erected in the Midland Counties, and is arranged as follows:—The main hall is illuminated by 20 3,000-C.P. arc lamps suspended from the roof, four lamps being placed in each of the five bays, and at such a distance from the ground that the full advantage of the arc is obtained without being in any way painful to the eyes. Two 3,000-C.P. arc lamps are hung, one over the entrance and one in Broad Street, for the illumination of the approach to the hall, and five lamps of a similar candle-power are suspended in the gymnasium for lighting that building during the conversazione. All the lamps are on independent switches, and may be switched on or off as desired, thus rendering any portion of the installation capable of being lighted as required.

The galleries and Old Birmingham, with the refreshment bars and tea rooms, and many of the exhibition stalls are illuminated by about 450 20-C.P. incandescent lamps. The lamps are suspended by flexible pendants generally, but in the Natural History Annexe an improved incandescent lamp shape, specially designed for house illumination by Mr. Henry Lea, is adopted, and the result is very pleasing. In the refreshment bar, dining room and tea room, three neat 9-light pendants are used, which have been specially designed and made for the meeting by Messrs. Hart, Son, Peard & Co., of Birmingham and London.

Where flexible pendants are employed, a very neat shade and holder, with ceiling plate carrying a cut-out, has been designed and used throughout by the Gülcher Company. This arrangement enables the pendants to be readily removed, if required, without interfering with the main leads, and also provides each lamp with a cut-out placed in the proper position.

The dynamos and engines are placed in a building outside the hall and open to the public. One 30-H.P. and a 25-H.P. nominal compound Robey engines, with locomotive boilers, are used for supplying the motive power, the two engines being capable of working 175 H.P., if necessary, but as only about 80 H.P. is required to drive the installation the plant is duplicate, each engine being capable of driving the whole of the dynamo machinery.

Four of the Gülcher Company's latest pattern compound wound dynamos are used to generate the current, but, as in the case of the engines, this plant is duplicated, as two of the dynamos will drive the installation. It will, therefore, be seen that the utmost precaution has been taken to avoid any chance of failure of the light.

The current from the four machines is led by cables underground to a very substantial main switch and cut-out board, which is placed on the company's stand inside the hall and then split up to the different circuits. Arrangements are also made so that any dynamo may be instantly switched into any circuit, or any circuit divided, part of the current being used for the arc lamps and part for the incandescent.

The company is also supplying power to seven exhibitions, and the arrangements have been carried through with exemplary success. Electricity is employed only as a secondary motive power, its function being to distribute to various machines, the force generated by steam engines.

A 10 H.P. Tangye engine, running at a speed of 180 revolutions per minute, and supplied by steam from one of Tangye's improved locomotive boilers, drives a No. 2 Admiralty type Gülcher dynamo, generating a current of 100 ampères which is conveyed to the working dynamos by covered wires carried under the flooring or along the girders of the building. Tracing the various currents, we find at the adjoining stand, that of the Royal Small Arms Factory, a 2 H.P. dynamo driving a rifle stock copying lathe.

At a more distant stand a 2 H.P. dynamo drives a diamond cutting machine, exhibited in action by Messrs. W. Spencer and Sons, of Birmingham. The speed of the three inch pulley of the dynamo in this case is 1,700 revolutions per minute, which is translated by a simple bit of counter-shafting into a speed of 2,500, at which the spindles of the cutting tools revolve.

A ribbon weaving loom at the stand of Mr. T. Stevens, of Coventry, is worked by a ¾ H.P. dynamo running at 2,000 revolutions per minute, which by counter-shafting is reduced by 55 revolutions, with a corresponding increase of power.

Messrs. Browett, Ashbury & Co., of Birmingham, illustrate at another stand the process of metal spinning, the machinery being worked by a 1½ H.P. dynamo, revolving at a speed of 1,700 reduced to 1,100. A wire carried 300 feet from the generating dynamo conveys power to a ¾ H.P. dynamo revolving at about 2,200 per minute, driving wire making and chain making machinery at 250 and 200 revolutions per minute. The exhibitors in this case are Messrs. T. Nicholls and Sons, of Birmingham.

The sixth dynamo driven from the Gülcher generator supplies power to the machinery of the English Watch Company in the Central Avenue. An obvious advantage of this mode of transmitting power lies in the fact that it renders unnecessary the concentration of manufacturing process in one part of the building. The six stalls worked from the one steam engine, through the medium of electricity, are scattered all over the exhibition in places where it would have been well-nigh impossible to convey power direct through the medium of shafting.

The speed of each motor is under the operator's perfect control, by his simply altering the position of a handle or resistance coil.

The motors were designed by the Gülcher Company, either as small power motors or dynamos for small installations, and are particularly convenient in all places where a small surplus power is available. They are made in four sizes, viz., 10, 15, 20 and 25 lights of 20 C.P.

A large depositing dynamo capable of depositing seven tons of copper per week of 144 hours, is exhibited in the Gülcher Company's stand, also a No. 1 dynamo for 50 20-C.P. lamps; small projector lamps, to be fed by hand switches of different kinds, arc lamps of globe and factory type, and other kinds of fittings connected with electric lighting.

THE NEW BRUSH MOTOR.

MR. BRUSH has for some time past, the *Electrical World* states, devoted his attention to the construction of a motor which should fulfil the conditions required in a successful prime mover. Steadiness of power and constancy of speed under all loads are two of the principal objects to be sought for, and in the new motor these have been provided in a very ingenious way.

The machine, which is illustrated in the accompanying engraving, fig. 1, closely resembles the Brush dynamo,

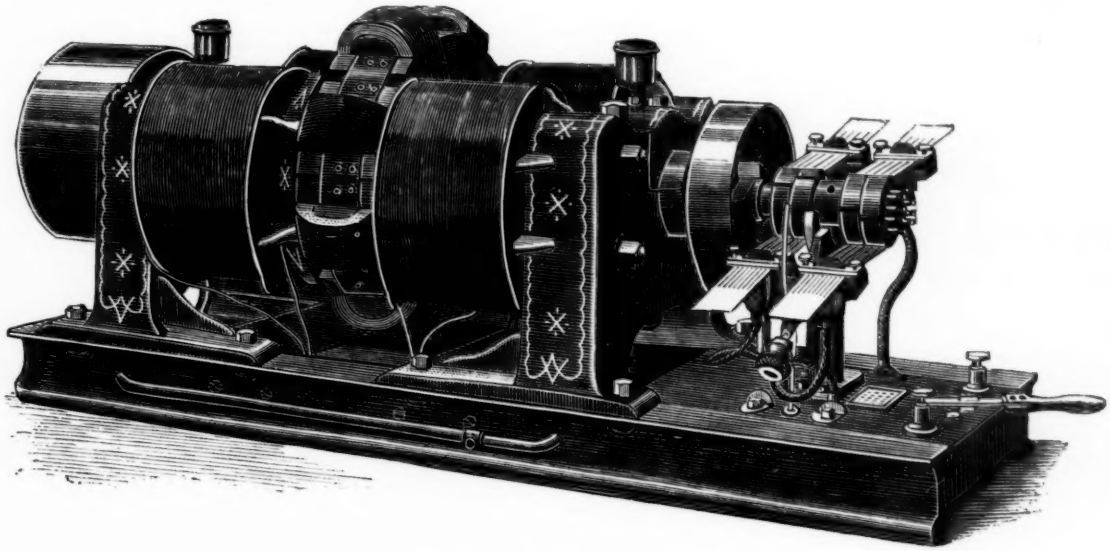


FIG. 1.

which is too well known to require extended notice; but the devices added to the machine for the purpose of securing the advantages above mentioned are decidedly interesting, and merit a detailed description.

It will be seen that, mounted on the shaft between the commutator and the journal bearing, there is a

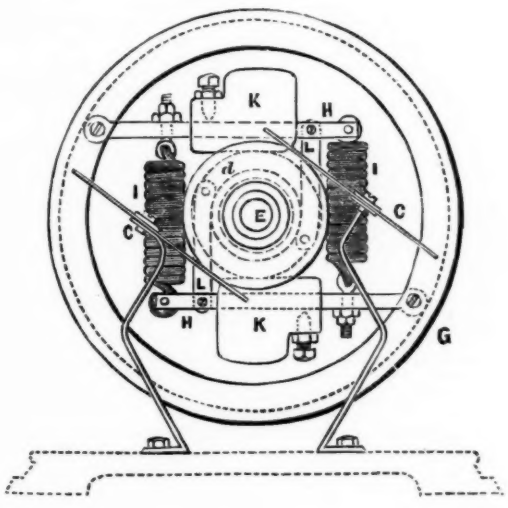


FIG. 2.

cylindrical shell. The shell contains the governor by which the speed of the motor is maintained constant. The mode of regulation adopted by Mr. Brush consists in causing the governor to adjust the commutator automatically with relation to the brushes. To this end the commutator segments are mounted upon a sleeve on the shaft, so that they can be revolved to any desired extent under the influence of the governor.

Figs. 2 and 3 show the governor in detail. As will be seen, the commutator brushes, C, C, remain fixed, and loosely mounted on the shaft, E, is the commutator sleeve, *a*, which turns freely. The commutator sections, *d*, are insulated from the sleeve, *a*, and are connected to the armature bobbins by flexible wires, so as not to interfere with the rotary adjustment of the commutator. To the inner periphery of the cylindrical shell, G, which is bolted to the shaft, the governor arms, H, H, are pivoted. The inner free ends of the arms are connected to the opposite arms by means of spiral springs, I, I. In addition, the arms carry each an adjustable weight, K. The links, L, L, attached to the arms, H, H, are connected to a disc upon the commutator sleeve. Hence, it will be readily understood that as the governor shell rotates with the pivoted weights, K, K, the latter, by centrifugal force, will be removed toward the periphery of the shell, and, through the medium of the connecting links, L, L, will impart a rotary movement to the commutator, varying its position on the armature shaft.

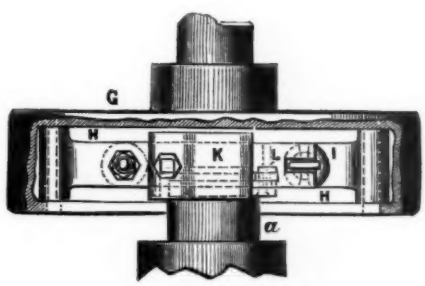


FIG. 3.

The action of the governor is precisely analogous to that in a steam engine. When in a state of rest, the springs draw the weights toward each other and maintain the commutator segments at the maximum point of effect with relation to the brushes. When current is switched on to the motor, the governor weights in their revolution are thrown outward and rotate the commutator, carrying the maximum points away from the contact points of the brushes and in the direction of rotation of the armature. This action decreases the effect of the driving current until a point is reached where the effect of the driving current is balanced by

the load on the motor, and the speed of the latter remains constant. Now, should the speed of the motor be retarded by a decrease of current strength with no corresponding diminution of load, or by an increase of load with no increase of current strength, the governor balls will be retracted and drawn towards each other by the spiral springs, and thereby rotate the commutator in a direction opposite to the motion of the armature shaft, the effect of which is to move the maximum points on the commutator nearer to the brushes, and thereby increase the speed of the motor. On the other hand, should the speed of the motor be increased above the normal rate, owing to an increase of current strength or to a decrease of load, the governor balls will be caused to recede from each other and rotate the commutator in the same direction as that of the armature shaft, and cause the maximum points on the commutator sections to be moved away from the brushes, and thereby decrease the speed of the motor. In this manner provision is made for all contingencies affecting the working of an electric motor. The parts constituting the governor are few and simple.

The Brush Electric Company, of Cleveland, O., is now engaged in the manufacture of these motors, which range from the smallest up to 40 horse-power.

INCANDESCENT LAMP PATENTS.

AT Cannon Street Hotel on Thursday last week a meeting of the electrical trade and others interested in electric lighting was held in conformity with a notice issued by the firm of Woodhouse and Rawson, and with the object of considering the position of electrical industries as affected by the decision in relation to incandescent lamp patents recently given by Mr. Justice Butt in the case of the Edison and Swan United Electric Light Company *v.* Woodhouse and Rawson. Vice-Admiral Sir Leopold McClintock, LL.D., F.R.S., presided. Representatives of the principal electrical firms and companies were present, and amongst those who spoke were Mr. Swinburne, of Messrs. Crompton and Co.; Mr. Offor, late of the various subsidiary Brush Companies; Mr. Paterson, of Messrs. Paterson and Cooper; Mr. Garcke, of the Anglo-American Brush Corporation; Mr. Goolden, of Messrs. Goolden and Trotter; and Sir Rawson W. Rawson, Chairman of the Pilsen, Joel, and General Electric Light Company, &c.

The CHAIRMAN said he had been invited to take the chair for the occasion, and he accepted the invitation with a full sense of the importance of the subject which was about to engage their attention. The circular sent out by Messrs. Woodhouse and Rawson [printed in the REVIEW last week] explained in some degree the object of the meeting, and he would now ask Mr. Rawson to give more fully his reasons for convening the meeting. He might say, for his own part, that his chief qualification for the post he filled was that he was a perfect outsider, and quite impartial. He hoped whatever result was arrived at would tend to the progress of electric lighting.

Mr. F. L. RAWSON: I have much pleasure in responding to the call of the chairman, and explaining to you in as few words as possible the reasons for calling this meeting. As you will see from the circular letter which has been sent to most of you, at a provisional meeting called last Thursday, my firm, Messrs. Woodhouse and Rawson, were requested to convene this meeting in order to consider the position that ought to he taken up by those interested in electric lighting matters with reference to the present course being pursued by the Edison-Swan Company. Many of you are aware of the parallel that there is between the unfortunate telephone monopoly and the threatened monopoly in incandescent lighting. In the telephone case there were two companies, Sir John Lubbock the chairman of one, and Mr. James Staats Forbes the chairman of the other, which, after threatening legal proceedings against each other, amalgamated, Mr. Staats Forbes being the moving spirit of the United Company. The Edison and Swan Electric Lighting Company is the parallel of this in the incandescent lamp world, Sir John Lubbock having been chairman of the Edison Company, Mr. Staats Forbes of the Swan Company, and the latter remaining chairman of the United Company. The holders of the Bell-Edison patents first commenced proceedings against a small infringer, and, after obtaining judgment against him, proceeded to obtain judgments against various other telephone makers, building up their patents step by step, until at the present moment those patents have been stretched to cover almost any kind of electrical telephone. The Edison-Swan Company are proceeding on the same lines. They commenced by attacking my firm when we were comparatively small and little known, instead of proceeding against any of the large companies which were then making lamps. Unfortunately for them, they pitched upon a firm whose progress has been very rapid, and whose position at the time the action was tried was entirely different from what it was when they commenced proceedings. It is hardly necessary for me to say that pending the hearing of the case we did our best to make a reasonable arrangement with the Edison-Swan Company for manufacturing on a royalty. The terms, however, which they asked were so onerous as to quite prevent the possibility of making a commercial success of the manufacture of lamps, unless the prices of the lamps were considerably raised. It is pretty evident that the policy they intend to adopt is that of refusing the right of manufacture upon a reasonable royalty to all makers whatsoever, and their views are shown by their recent oppressive action towards users of incandescent lamps. It is almost unnecessary for me to state that owing to the rivalry of gas and other illuminants, and partly owing to legislative action, the electric lighting industry is in such a state that, although rapidly improving, it requires not only that all our energies should be devoted to the working out of details instead of squabbling amongst ourselves, but it also requires that prices should be kept as low as is possible consistent with a fair trade profit, and a monopoly in incandescent lighting, or even in incandescent lamps, at the present time would throw back this industry as much as the telephone industry has been thrown back in this country, and possibly more, to say nothing of the prejudice that would exist in the public mind. To prevent this monopoly we have done our best. Not only have we spent a very large sum of money in fighting for the benefit of the trade, sparing no expense, but the time given by us has considerably hampered the development of our business, and it has also materially contributed to the breaking down of Mr. Woodhouse's health, who I regret to say has been away from business now for nearly twelve months, as many of you are aware. Our time and trouble and money have, however, by no means been thrown away. Mr. Forbes, the chairman of the Edison-Swan Company, stated at their general meeting that they had been successful in their action on every point, and this misleading statement has been also published in the newspapers in various countries. Now this is not at all the case. The plaintiffs attacked us on the Edison patents and also on the Swan patents. By many people it was thought that the Swan and Gimingham patents, originally the property of the Swan Company, were quite as strong as the Edison patents. These two Swan patents we broke down completely, and out of the four claims of the Edison patent there was only one claim on which we were defeated. The second patent that was upheld was the Cheesbrough. This patent had originally 30 claims; being drawn up on the usual American system of making as many claims as possible, in the hope that some one of these may give the patentee a chance of blackmailing successors who may have the expense and trouble of working out the details foreshadowed in the claims. Nearly the whole of this patent, together with 27 out of the 30 claims, was disclaimed, and, owing to the inherent difficulties of understanding the case, the patent was upheld notwithstanding our having so distinctly proved our case out of the mouths of the plaintiffs' witnesses that we did not consider it necessary to call our own witnesses. With regard to this action I feel sure that on the evidence already given if we can get the Appeal Judges to thoroughly understand the case we shall win. With regard to the Edison patent, should even Mr. Justice Butt's decision be upheld, which we are advised by our council, including the late Solicitor-General, Sir Horace Davey—whose opinion stands as high, if not higher, than any council in patent cases—is not likely to be the case in either of the actions, the Appeal Court will have to state the point at which low resistance lamps end and high resistance lamps begin. If they take the same view of the case as Mr. Justice Butt the patent will give no monopoly, for, according to Mr. Justice Butt's opinion, although he would not lay it down as law but left it to the Appeal Court, we can make lamps up to 100 ohms without infringing Edison's patent, this will allow us to make lamps up to 60 volts, which will be quite enough for most practical purposes. If, however, the appeal is dropped the decision stands good against lamps of any resistance. A combination against monopolies is by no means a new thing. It has been successfully done in many instances; for instance, in the bicycle trade, in the sewing machine trade, and many others. At the present moment there are three or four combinations of this sort besides almost a precisely similar combination in the electrical trade in Germany at the present time for the purpose of resisting a monopoly of the Edison patents over there. (Mr. Rawson here drew attention to a circular received from three leading firms in Germany asking his firm to combine with them.) It has been contended that it would be better to wait until the Edison-Swan Company made a monopoly. This was exactly the argument used in the telephone case and there the result has been shown. It does not do to shut the stable door after the steed is stolen. Should we not carry our case to Appeal there must be a monopoly for at least twelve months, as an injunction would be at once granted against anyone making incandescent lamps, the case having been once decided; and if a fresh attempt were made to open the question it could not be heard for at least twelve months—ours took two years. Moreover, those opening the question afresh, in the event of their losing, would have to pay solicitors' and clients' costs. I am sure very few would wish to combine to break down the Edison-Swan Company's patents if they believed that the company were fairly entitled to the monopoly, and certainly we would not. There is no doubt that the claim on which we were beaten, which was one of the widest possible character, was put in by Edison as a kind of sweep net to cover, if possible, all forms of incandescent lamps, knowing that he could disclaim it if necessary. It is a noticeable fact that this claim is different in his German patent. A good deal was made during the trial, and has since been made, of the alleged fact that Edison was the inventor of the incandescent lamp, and that it is through his exertions that incan-

descent lamps are a success. There is no doubt that the judge, believing this, strained the patent to uphold his monopoly. From our position as manufacturers of incandescent lamps from a very early period, and also from the close researches we have made in preparing our case, we ought to be in a position to give an opinion, and we would certainly not give the credit to Edison. There is no doubt that to Mr. Swan, working with Mr. Stearn, and also to Mr. St. George Lane-Fox, is due, not only the credit of perfecting the incandescent lamp, but actually the introduction of them into this country. By examination of Mr. Lane-Fox's patents, which were considerably prior to those of Mr. Edison and Mr. Swan, it will be found that he at an early date had mastered all the essentials of the manufacture of an incandescent lamp. There is also no doubt that Mr. Swan was a long way ahead of Mr. Edison in his work. A leading feature of the trial was that they did not venture to put Mr. Swan into the witness box as their witness. We, of course, could not do so as we could not cross-examine him. I fear that my firm could not, unaided, bear the expense of taking this case to appeal, and I may mention that we have met with promises of support from nearly all the leading members of the trade. I think that the expenditure of more money in fighting may be unnecessary, although it must be ready, for I think that if the trade combine together, and enough money is subscribed to show the Edison-Swan Company that the trade is not only prepared to fight the appeal, but, if necessary, to carry the case to the House of Lords, they would be likely to allow those subscribing towards the costs to manufacture and use lamps on a fair and reasonable basis. There is, I am afraid, only too much cause to lead one to believe that this attempt of the Edison-Swan Company will not be the only attempt in the electric lighting world to obtain a monopoly by means of retaining nearly all the leading counsel and expert witnesses to stretch patents, on the ground that they involve a principle and are not patents for details. United action, however, of those interested in this case will probably prevent anything of the kind occuring.

Mr. ADAMS: Might I ask what the terms of royalty were that were asked? You say they were onerous.

Mr. RAWSON: The terms they have asked our firm are lower than those they have asked from some other people. Two shillings per lamp royalty they have asked in some cases, but they offered us less than that. Still the terms were such that we could not have made a profit: we should have lost money in manufacturing the lamps.

The CHAIRMAN: I think Mr. Swinburne is present. Perhaps he will be good enough to give his opinion.

Mr. SWINBURNE said it was a little difficult for him to do much in this matter. He was Messrs. Crompton's scientific manager, and it was difficult for him to do anything without compromising them. It seemed to him the only difficulty was to get the trade themselves to see that this question affected them. They looked upon it as a question concerning only the incandescent lamp makers, of whom there was quite a small number. He could not quite see that that was the case. Lamps at present ran to 5s. each, and if the Swan people got the monopoly they would be able to do what they liked, the price of lamps would never fall to the figure it might otherwise do, and the trade would be able to do nothing to prevent them from absolutely refusing to sell lamps outside to trade customers generally. Makers could not even get licences to sell, as they could do in cases which came under the new Patent Law. The Edison and Swan Company might say, to anyone using our dynamos we will supply lamps at 2s. 6d., or they might fix up an installation and charge yearly, and, in fact, gradually work the whole business into their own hands. This was a most important point of view from which the question should be regarded. The lamp makers were concerned in a small way, but the trade was much more concerned. The makers were no more concerned than in the case of the telephone monopoly were the little people who made coils and electro-magnets.

Mr. RAWSON said that several users of incandescent lamps to whom he had written upon the subject replied in very strong terms indeed. One well-known man who had had his house lighted with incandescent lamps for four years said: "Such a monopoly as the Swan-Edison Company seek to establish will simply stifle improvements and any kind of progress in electric lighting." They all spoke in that strain and pointed out that the price of lamps was a very serious matter in an installation. In the north the cost of lamps was the most important thing, the thing to which everybody looked. He knew of many cases where if his firm could have offered to put in lamps at a price 25 per cent. less than they were able to do at present, they could have obtained contracts, and he was quite sure the cheapening of lamps would lead to an enormous extension of business. At mills in districts where the cost of coal was only about 5s. per ton and the cost of machinery was comparatively slight—dynamos only were required, and in many cases they ran night and day—by far the most considerable item was the cost of the lamps, and if they could manage to reduce that cost to 2s. 6d. per lamp there would be a large increase of electric lighting in those districts. As it was now, their calculations came out that where there were long hours electric lighting was slightly cheaper than gas, and such a reduction as he had indicated would lead to its adoption where lights were required only a few hours. That experience would probably be borne out by a great many people in that room.

Mr. BAILEY said he wished to make a proposal, which was that there should be a committee formed, to consist of practical and scientific men and those interested in the making of incandescent lamps, as well as of electrical manufacturers generally. Such a committee might be able to give information and advice of great value to Messrs. Woodhouse and Rawson in the conduct of their case. He had heard since coming into the room that they would not be allowed to introduce any evidence when the case came before the Court of Appeal which had not been given at the first hearing. Was such the case?

Mr. MORSE said they could not introduce fresh evidence without the leave of the Court. If there was any further evidence which might be put before the Court it would be necessary to make application to the Court for leave to use it.

The CHAIRMAN: There would be no difficulty in obtaining permission, I presume.

Mr. MORSE: It is entirely in the discretion of the Court, and no one can say. There is no right.

Mr. PATERSON, in response to an invitation from the chairman, to state what he knew of the consequences of the telephone monopoly, said he knew a little about the telephone on the Continent as compared with its position in England. Taking, for instance, the town of Christiania, where the use of telephones is entirely free, the subscribers to the telephone exchange there had the use of the exchange for from £2 15s. to £3 a year. The way they managed was, they united together and each man bore a proportion of the cost of installing the exchange and also of maintaining it. The cost being thus divided, and there being no excessive royalties to pay, no monopoly existing, they obtained all the benefits that telephone subscribers had in London for about one-sixth or one-seventh the cost. He did not know whether the abolition of royalties on lamps would lead to the cheapening of electric lighting, but unquestionably in the manufacturing districts of the north, if the price of lamps could be reduced it would be the means not only of doubling their trade but of increasing it 10 or 15 times. He was perfectly certain of that from his own experience.

Mr. MORSE said, with reference to a point which had been raised, it might be advantageous for him to explain exactly how they stood, and they would then see how simple the matter was and how reasonable, as he thought, their belief that the appeal would terminate in their favour. The question depended upon two patents. The first in order of date was Cheesbrough's patent, which, as they knew, was for depositing carbon upon the carbon filaments. The actual claim was "preparing the illuminating part of an electric lamp by heating the same electrically in a hydro-carbon gas." If they could prove that the thing patented was old, was known to the public, or was published in a book to which the public had access, prior to the date of the patent, the patent would fall, for this reason: if a man invented a secret thing, the Government bought the secret from him and a monopoly of the use of that invention for 14 years was the price paid. It was just a bargain of that kind. Therefore, if the thing was known before there was nothing to sell. Cheesbrough's patent was for electrically heating the illuminating part of an electric lamp, whether carbon, platinum, or anything else, in a carbon gas. They proved that it was well-known before the date of the patent that if you electrically heated a piece of carbon enclosed in a glass vessel containing a hydro-carbon gas, that carbon was dissociated by the electrical heat and deposited on the piece joining the two poles, with the exact result that you had this particular invention. The only point the judge could lay hold of in the patent in order to, if possible, uphold the patent was that the patentee said that if you increase the current there is practically no limit to the deposit. It was perfectly well-known before 1878 that the deposit could be increased as the current was increased, and their counsel told them that they had proved by the plaintiff's witnesses exactly what they wanted to prove, and there was no case any further for the plaintiff on that patent. If he had explained it clearly, he thought they would see that they had very good reason to be confident on that case. With regard to the other patent, Edison had four claims. First, for a filament of carbon of high resistance made as described and secured as set forth. Unless they made the filament as Edison described and secured it in the same way as Edison they did not infringe that claim, and he supposed there was not a single manufacturer who did make and secure as Edison did. The second claim was more important. It was for the combination in an electric incandescent lamp of a filament of carbon of high resistance within a receiver made entirely of glass, through which the leading wires passed, and from which the air was exhausted, for the purpose set forth. The chief answer they had for that was Mr. Swan's well-known lamp exhibited at Newcastle. That lamp was shown in court. It consisted of a piece of carbon ·04 inch in diameter and 1½ inch long. This passed through from one end of the lamp to the other and was not in the ordinary horseshoe form. It was a vessel made entirely of glass and containing a vacuum. Therefore, the only difference between that lamp and those now made was the size of the carbon which by being heated gave the light, and the sole question to be fought upon that patent, if the law was correctly laid down upon other points, was whether Swan had anticipated Edison; that was to say, whether you could get a patent for reducing the diameter of the filament. They said, if so, where are you to draw the line. As he understood it, some lamps, the 100 C.P. lamps for instance, had very large filaments; they might not be so thick, but much wider than that in Swan's lamps: the total sectional area of the 100 C.P. lamp might be greater than in Swan's lamp. The other question was rather more complicated. They (Woodhouse and Rawson) proved that the filament of carbon was old, that the glass receiver was old, and that a carbon lamp with a vacuum was old; and not only did they prove that the whole of the parts were old, but also the whole combination. The simple question for the Court of Appeal

was whether the combination of a *filament* of carbon in a receiver of glass, &c., was new or old.

Mr. OFFOR said he hoped the meeting would not separate without giving free expression to opinions which he had no doubt they as a body held with reference to the great importance of this question, especially to the trade who were pushing the electrical industry. He would refer to a notable instance of the result of the proceedings of the Edison and Swan Company so far as they had gone. As Mr. Rawson pointed out, as soon as the decision was given in the Court the Edison Company gave notice to the public generally who were using lamps that they must remove all lamps that were not of Edison's manufacture. In the case of the interesting installation to which he was alluding, which was well-known to the trade, and which after some two or three years' running had at last been stopped, he believed that one of the last straws that broke down that installation—he was alluding to the very interesting installation at Colchester—was the users' receiving a notice from the Edison Company that they must remove all lamps not made by the Edison Company. Those lamps included lamps manufactured by the Brush Company, by Woodhouse and Rawson, and others; and the trade must see at once how that feeling getting abroad amongst the public must injure the progress of the trade, entirely apart altogether from the more technical questions. It was perfectly clear that all improvements in lighting must be seriously hampered, for was there a scientific man who was devoting his attention to the improving of any part of electrical apparatus who was likely to proceed with improvements when there was this master patent—this monopoly—against him? The matter was of so serious a character that he hoped all who were interested would lend their aid; not merely the manufacturers of lamps, but the trade generally, for it affected them far more than even manufacturers of lamps, because the trade had not only to hope for a better article but a cheaper article, neither of which were they likely to get if this decision should be upheld, even if they got anything at all. He thought, therefore, the trade should do what they could, at all events, to carry this case to another Court, in order that, if possible, this judgment, which appeared to be so unrighteous a one, might be reversed.

Mr. GRUNDY said, with regard to the remark that had been made about improvements, he had an opinion of his own upon that subject. The improvements they had had of late years in the efficiency and life of incandescent lamps had been due to outside manufacturers. He was speaking some time ago to a well-known maker of dynamo machines, who said that as a maker of dynamos he preferred the lamps of Woodhouse and Rawson, but he was so mixed up with the Edison and Swan people that he was bound to recommend theirs. He (Mr. Grundy) thought there should be some means of making the Edison and Swan Company either put as good a lamp on the market as other people did, or else of allowing them to exact only a very small royalty.

The CHAIRMAN: From what I have learnt since I entered this room, it appears to me that the interests of the public are identical in this case with those of the manufacturers of lamps; but I think it is the duty of the general manufacturers in the trade to come forward and maintain their rights.

Mr. SWINBURNE said, with reference to the question of improvements, they had been told that other makers besides the Swan Company seemed to bring most of the improvements forward. He went further, and said that the Swan lamp was much the same now as it was in 1882; in fact, the best Swan lamps he had seen were those manufactured in 1883. There was very little chance, if there was no competition, of any improvements being made in those lamps. He did not think people sufficiently recognised that electric lighting must go forward. They would have seven years' servitude to go through if they allowed the Edison-Swan Company to have their own way, and the business would be in a very queer position if it were allowed to remain in the hands of one firm, which stuck in the mud year after year. He had gone through the case in the law courts pretty carefully, and it seemed to him that the whole thing was to be explained in this way: There was a judge who simply did not understand the thing at all, and on the other side were very able counsel. The judge took it for granted that the case was going to appeal. Probably he would have reconsidered his judgment, or would have given a different decision, if he thought it was not. He did the best with the case that he could. The secret of the success of the other side was in getting the judge to misunderstand the thing. It was very difficult to make a judge understand technical matters. Witnessing was a sort of special business—people had to be educated for it—and the other side had very good witnesses. Things were put in such a way that it was very difficult for anyone who thoroughly understood incandescent lamps to avoid giving the answer the other side wanted. It was very hard for any man to get up and contradict Sir Frederick Bramwell on the spur of the moment, notwithstanding that throughout the case he was often talking absolute nonsense. He supposed the appeal would not present so many difficulties, for when you knew the enemy's points it was much easier to manage the case. He thought it would be well for the meeting to call upon Messrs. Woodhouse and Rawson to form a committee of some of the leading people in the trade, because much could not be done by a large meeting; what was everybody's business would be nobody's business in particular.

The CHAIRMAN: I understand Mr. Garcke, secretary to the Brush Corporation, is in the room. We should be very glad indeed if he would express his views on the matter before us.

Mr. GARCKE said with regard to the action of the Brush Corporation, he was instructed by his board to attend that meeting, and to say that they were not indisposed to support Messrs. Woodhouse and Rawson pecuniarily in carrying their action to the Court of Appeal, provided there were five or six other leading firms who were willing to do the same. His board would not, of course, consider the question of doing this except on certain conditions, some of which were that the money to be provided should be subscribed equally by those five or six firms, that Messrs. Woodhouse and Rawson should undertake to carry the case to appeal and, if desired by the guarantors, to the House of Lords; further, that Messrs. Woodhouse and Rawson should not do anything contrary to such a course without the joint permission of all the guarantors. He did not think, having made that statement, it was necessary for him to say anything further.

Mr. MORSE said, as representing Messrs. Woodhouse and Rawson, he might be allowed to explain that what Mr. Garcke had said, with reference to several firms joining together and subscribing in equal amounts, was matter for common arrangement. As to the other conditions, that Messrs. Woodhouse and Rawson should do nothing without the consent of the guarantors was most reasonable and a *sine qua non*, for where half-a-dozen interests were represented it was not right in any way to go behind those who were concerned.

Mr. GOOLDEN, being called upon by the Chairman to give his views as a manufacturer of dynamos, said he came rather to hear what others had to say and to know what was going to be done generally. He thought this matter certainly did affect dynamo manufacturers as well as others, about equally with the public. It would be a great misfortune in several ways if there were to be a monopoly even in incandescent lamp manufacture. They would get no improvements for one thing. At present dynamo manufacturers looked upon the price of incandescent lamps as one of the main obstacles to the progress of incandescent work, and they would view with very great dissatisfaction any monopoly of the kind threatened, which would only increase their difficulties.

Mr. SWINBURNE then moved that Mr. Rawson be requested to form a committee to proceed further with the matter. The committee, he thought, should really take up the business of that meeting. A large number of people could not tackle a question very carefully, and it would be better to concentrate their energies into a smaller body in order to get business done.

Mr. OPPERMANN seconded the motion, remarking that it was very difficult in a large meeting like that to get people to say really what they thought, and if they formed a committee they would be able to get the opinions of people privately, and so more thoroughly ascertain the feeling of the trade. With regard to the suggestion of the Brush Company, that seemed to him to resolve itself into a monopoly in another sense. Their suggestion was that a few of the large firms should join themselves together and subscribe a large amount of money in equal sums. That, in his opinion, would keep out a great many smaller representatives of the trade who, joined together, would represent a large amount also. In the event of the appeal being heard, could any estimate be formed of the expense, and could it not be met by a general subscription, a large number of firms contributing comparatively small amounts? Such a course as that would probably meet with more approval than the combination of a few members of the trade giving large amounts. It seemed curious that such an influential and well versed man in the subject of incandescent lamps as Lane-Fox should not have been called in the recent trial. He could have told them a great deal more about incandescent lamp making than a great many people who were called. He was connected with the subject long before Edison.

Mr. MORSE, replying to the remarks of the last speaker, said he believed if the Appeal were lost and they had to pay the costs of both sides, those costs would certainly be covered by £2,500. It was difficult to estimate what the whole of the expenses would be; it depended a great deal upon the taxing master, who, however, always allowed large fees to counsel. With regard to Mr. Lane-Fox, they put a brief to counsel of Lane-Fox's evidence, as of many other witnesses, but, as they knew, they were obliged to leave the management of the case to counsel, and counsel did not consider it necessary to call several of the witnesses they had ready.

The motion of Mr. Swinburne was then put to the meeting and received unanimous approval.

Sir RAWSON RAWSON, with a few remarks, moved a vote of thanks to Sir Leopold McClintock for presiding, and the latter, in acknowledging the vote, said he was very pleased to assist in preventing a monopoly which he was quite sure would seriously affect the public interest. He hoped whatever was done would lead to the peace as well as the progress of the electrical industry.

The meeting thereupon terminated.

THE SPRAGUE ELECTRIC RAILWAY SYSTEM.

ANNOUNCEMENT was made some time ago that this system was under trial, and for some time past it has been in experimental operation on the north track of the Thirty-fourth Street branch of the Manhattan Railroad. Car No. 293, a full-sized standard passenger car of the elevated railroad, was recently placed at Mr. Sprague's disposal by the officers of the Manhattan Company, and the *Electrical World* states that this has been equipped and is now a thorough-going experimental car in which a great many problems are being worked out.

The great amount of power which is used on the elevated rail-

roads and the distance over which the trains are handled, necessitate in the electric circuit large currents of a high potential. The potential decided on was 600 volts, and the experiments on the Thirty-fourth Street section have been carried on with that pressure. No such electrical potential has ever been used in practice for this kind of work. The occasion for it has not existed, and motors which might be used with small powers over short distances and with low potentials would not avail there. Some idea of the current and potential necessary for operating the Third Avenue line may be easily gathered from the following facts.

There are at one time 4,640 H.P. actually being developed. With an efficiency of 80 per cent. for the motors, this would mean a current of 43,291 ampères if one hundred volts were maintained at the terminals of the motors. With 600 volts this would be reduced to 7,215 ampères. The handling of a current of 7,215 ampères and of from 600 to 665 volts electromotive force is a somewhat difficult matter. A conductor to carry this amount of energy without a very large loss under ordinary conditions must be large, but with the stations properly put in and with the rails properly reinforced, together with the methods of working which will be described more in particular below, it will be seen that the difficulty of handling this has been very largely reduced. We will now enter into a somewhat technical description of this system, both with regard to what is being done and what will probably be done in the future.

The first subject to be considered is the generating station. The system preferred by Mr. Sprague is the operation of a number of dynamos wound so as to generate at their normal speed and with a full load an electromotive force of about 670 volts at their terminals. These dynamos are wound for constant potential circuits. They are of very low armature resistance, and have high resistance shunt fields. The dynamos may be built so as to maintain a constant potential under all loads at the junction of the mains with the track. There is one disadvantage, however, about this, and that is, if the electromotive force of the dynamos rises automatically, and there should be any very serious cross on the line, the machines might be burned out. Where they are wound with the field magnets in a simple shunt circuit, and no cumulative coil in series with the armature, any very bad cross on a line will lower the potential at the terminals of the machines, and while a very heavy load will come upon them for a brief interval of time, the drop of potential at the terminals will be sufficient to so far demagnetise the field magnets that the machines cannot be burnt out. In addition, however, to the ordinary shunt coil, Mr. Sprague employs a special winding, one which now appears in his railroad motors. This special winding is a coil in series with the armature, whose polarity is exactly at right angles to the polarity set up by the shunt coils, and is so proportioned that it automatically maintains the point of non-sparking coincident with the line of contact with the brushes on the commutators. This series coil would not have the effect of an ordinary cumulative coil. It would not raise the potential of the dynamos, but simply makes them non-sparking with fixed brushes under all loads.

Considering the length of road and the amount of power used it would be better to have two central stations rather than one. These stations would be of the most improved possible mechanical construction. The engines would be compound, condensing, and placed near the water. By this means the coal consumption could be reduced at the central station to as low as 2 lbs. of coal per indicated horse-power. By having two stations, each removed about a quarter of the distance of the length of the road from either end, the size of conductor which is necessary for the middle rail is only one-fourth that which would be required were there only one station in the middle. Furthermore, the points of supply of current from each station should be maintained at the same differences of potential, to obtain which Mr. Sprague runs an independent line wire from station to station, with suitable indicators in it, showing whenever there is any inequality of potential existing at the supply points. This is done because the highest possible economy requires perfectly equal differences of potential at all points of supply, no matter how many the trains, nor where they may be situated on the track. The combined capacity of the two stations would be something more than equal to the highest total horse-power appearing at any one time on the road, which, as we have seen, is about 4,700 horse-power. It will be noted that there are no losses allowed for here. Why this is so will be explained in describing the system of braking which is used. This, then, would give a capacity at each station of about 2,500 horse-power. On account of the rise and fall of the work done on the line, it being light at night, somewhat heavier during the middle of the day, and at its maximum during the morning and evening, this 2,500 horse-power would be divided up into about four units, and to allow for any break-down of an engine these units would be of about 800 horse-power each. The travel on the road is so perfectly known, and follows such a well-defined law of increase and decrease, that there would be no difficulty whatsoever in starting the engines at the proper time and throwing the dynamos into circuit. This system of power generation would be the most economical possible. With improved boilers and improved methods of burning cheap fuels, and with high grades of engines, compounding and condensing, results would be obtained which would be very gratifying.

We come now to the system of distribution, and this will be described more particularly with regard to the demands of the elevated railroads, leaving out particular reference to street roads, which form a department by themselves. There are many things which pertain to this system of distribution which would, of course, appertain to street work. The main rails are grounded, and form one side of the circuit, being connected to the structure of the road at suitable intervals. Four single rails, together with the superstructure and the ground connections, form a path of very low resistance, and there would probably be no need of any reinforcement at the fish plates. Should such reinforcement be found to be advisable, a short connecting piece would be made from one rail to another, very much in the same manner as is now done where the track is used for electric signals, or, as with the middle rail, a main conductor would be used. The other part of the circuit consists of a very light rail of special construction, thoroughly well insulated in a simple manner, and raised so that its top is from 3 to 4 inches above the plane of the ordinary traffic rails. This rail is not continuous, being of necessity broken at all switches, turn-outs, sidings, and cross-overs. The ends terminate about 18 inches from all crossing traffic rails, and instead of ending abruptly, they are bent down slightly, so that when the collecting wheels, running on the central rail, leave or enter them, they do so without any shock or jar to the spring mechanism which carries them. This middle rail is further divided up into sections of any convenient length desired, say at intervals of 500 or 600 feet.

In addition to this middle rail, there extends along the entire length of the line a heavy, continuous conductor, thoroughly insulated. This is connected to both ends of each section by fusible plugs or cut-outs and a short branch circuit. The branch circuits of the cut-outs form a Y connection, the main conductor being secured to the stem of the Y and one end of each section to the arms of the Y. It will be seen now that in the normal condition of affairs if current is flowing from one part of the road to another part and there is no train between these two parts, that this current is carried over a double ladder-like circuit. The main conductor carries the major part of the current and the sectional working conductors a smaller part. So long as there is no train on the sections adjacent to any connection, it is evident that there is no difference of potential existing at the two opposite ends of the connecting branch, and no current will flow over it, although very powerful currents are flowing past each end of it. These currents will, of course, be in the same direction. When, however, a train enters a section it does not make any contact whatever with the main continuous conductors, but only with the working conductor, and current is supplied to this working conductor from both ends, partially, it may be, through the working conductors next adjacent, but mainly through the branches connecting it to the main conductor; that is, there is a difference of potential set up in the different parts of these circuits and parts which were inert before become active the moment a train passes on to a section, no matter whether the train be taking current from the line or giving it to it. The current that flows through these branches may be made to actuate any kind of special device which is necessary, and thus forms a perfect block system of signalling, which operates by the presence of a train upon a section, since this train automatically sets signals at both ends of its section. These signals are of a variety of kinds, visual or audible, or both. Some are day and some night signals; and the incandescent lamp, preferably two or more in multiple circuit with each other, are used for the night signals. Since the current on a motor is under perfect control, it follows that even if the train is at rest on the section, the engineer is able to set his signals.

One of the great advantages of this system of main and working conductors is this: If there is any bad cross or accident on the line the section will be cut out. The rest of the road will not be interfered with in the slightest, but the whole circuit will remain intact with the exception of the one particular branch of 500 or 600 feet, which has been affected. The signals may be made of that automatic character such that when a cross does occur sufficient to break the safety catches of that particular section a signal is set and cannot be replaced until the section is repaired. We have here a perfect safeguard against any extended disabling of the line. Furthermore, if it becomes desirable at any time to operate a signal at only one end of the section, the other end of the section can be cut out. If repairs are made, a section of the road being taken out or replaced, the track foreman can at once cut that particular section out of circuit, and after his repairs are made put it in again without interfering with the main line. In addition to these devices, the main working conductor can be divided up into sections and switches inserted, so that if it be desirable to cut out any extended portion of the track, in case of any accident which makes the passage over a section of the track inadvisable, as in case of a fire, that portion can be cut out without the necessity of disconnecting each individual section.

In addition to these arrangements, the conductors of like potentials on different tracks and switches are connected by cross circuits which tend to equalise the potentials on the line, especially where there are any bad joints in the rail, and also when one track is more heavily loaded than the other. Another great advantage of these cross connections is that the current generated by trains running on down grades and stopping, can not only be sent back to the conductor on its own particular track and circulate through the system, but it can take a shorter and more direct path to the opposite track, where a train may be moving on the up grade or just starting. It should be further stated that both tracks are supplied from the same source, forming one complete circulating system. All motors are run in parallel circuit with each other the current in each being independent of the current in all others, and the motors on the one track are in parallel circuit with the motors on the other.

We now come to the question of motor construction. The

elevated railroad presents a special problem, as the strength of the superstructure is limited. At present the trains are drawn by locomotives which aggregate about twenty-two and a half tons in weight. Of this weight only fifteen tons is available for traction, this being the weight on the drivers. This weight of twenty-two and a half tons is centred in a very small space. Immediately behind the locomotive is the forward truck of a car, with a proportionate weight of nearly nine tons. There is then a total weight of over thirty-one tons in a space of about thirty-six feet, which is less than the distance between two columns. The consequence is that the strains, both tensile and shearing, are very great; but these strains are not the only source of danger. The vibration set up by a moving train, both vertical, due to the weight, and longitudinal, due to the motion of the train, has a shattering effect which is very great. It tends to loosen the bolts and badly strains the whole structure. There is an additional vibration due to the reciprocal strokes of the steam locomotive and its consequent unevenness of pull. If an electric locomotive were applied to handle a train, and it was made of fifteen tons weight it would pull more than a steam locomotive of equal weight, since all of it could be put upon the driving-wheels, and there would be no necessity for additional truck wheels. But a fifteen-ton electric locomotive, properly constructed and handled, would pull even more than a twenty-two and a half ton steam locomotive with fifteen tons on its drivers. If the weight was distributed on four wheels, the wheels being on two perfectly independent axles, there would be absolutely equal pressure on each. This, however, is not the case with a steam locomotive. In addition to this, the strain could be simultaneously brought on all the wheels of an electric locomotive with such a perfect progression that they would adhere to the rail more firmly than an equal weight where the motion is derived from a reciprocal movement. Furthermore, there is a certain amount of increased adhesion of the wheels, just how much it is impossible to say, because it varies under different conditions, and this is probably due to the heating effect of the current passing from the rail into the wheel.

Another method of handling the cars, and this is the most logical, although it may be a somewhat more costly method of working when dealing with old rolling-stock, is the placing of the motors underneath the cars on the trucks which carry them. In this way at least one-half of the weight of the car and the passengers, as well as the motors, is available for traction.

If the motors are thus placed under the cars, each can be made an independent unit, or a dozen cars can be operated in a single train by a small regulating truck placed ahead of them.

This is the manner in which a single car is now being operated on the Thirty-fourth Street branch of the Third Avenue Elevated Railroad in New York City. The truck upon which the car is mounted is shown in perspective in the fig.

As will be seen, it represents a standard iron truck, such as is in use on all the new cars of the elevated railroad, with, of course, some omissions and changes which were necessary for attaching the motors. The principal omission is that of all ordinary braking apparatus. There are two motors carried on this truck, each in the space between the axle and the centre cross-piece. The field-magnets, which are made of the finest selected scrap wrought iron, are built up of four segments, all forming parts of circles. Two of these form the pole-pieces and to these are attached heavy bronze hangers. The latter carry the armature, which is wound on a special modification of the Siemens system, and has at each end forged steel pinions of 3 inches face and 3·7 inch diameter on the pitch line. There are 13 teeth only. The hangers are extended and embrace the axle, which is turned off to a perfectly smooth surface, leaving a small shoulder at each side. Part of the hangers extending from the magnet pole-pieces embrace one-half of the axle, and the opposite half is embraced by heavy bronze caps, and inside each there are split liners to take up the wear. The armature shaft, as it passes through the hanger, is carried by two curved self-concentrating sleeves.

On the axles, close to the hub of the wheels on each side, are two split gears. These differ in character. One is keyed and bolted directly on to the axle, which is first turned off, and is a fixture. The other is composed of four parts, two being inner webs which are keyed on to the axle; the two outer ones form the geared section and are bolted together and have corresponding webs projecting inwardly, and fit snugly both on the outer edge and on the face of the webs which are keyed to the axle. The outer and inner webs are held together partially by the method in which they are turned up, but principally by bolts passing through them which work in curved slots. These, then, constitute adjustable split gears, and are probably a new thing in mechanics. The gear wheels are of an especially fine grade of cast-iron, and are of the same face as the pinions which mesh into them. The number of teeth in these gears is 66; they are of the involute cut, so that if the motor should be moved to or from the axles slightly, the gears will still run perfectly true, with only a little more or less closeness of meshing. The pinions on the armature shaft are set so that the one is half a tooth in advance of the other. Ordinarily, it would be a very difficult matter to get the splines on both the armature shaft and the axle and in the pinion and gears, so that they would mesh smoothly when running forward and backward, and it was for the purpose of getting rid of this trouble that the adjustable split gear was designed. It is now only necessary to key the two pinions, one fixed gear, and the web of the other gear in position without any regard to their meshing. The motor is then swung into position, the hangers made to engage the axle, the caps are put on, and the motor being moved forward and backward two or three times while the bolts of the adjustable gear are slack, this gear will assume a perfectly correct position. The bolts are now tightened up and there is thus a nest of double pinions and double gears all meshing with absolute precision, no matter whether the motor runs backward or forward. The method of mounting produces a concentric motion, and by this means the driving and the driven axles are maintained absolutely parallel in two planes under all circumstances.

To allow the motor freedom to follow all the movements of the independent axles over frogs and switches, and also for taking part of the weight of the motor off the body of the axles and to throw it on to the boxes, one end of the motor is suspended at its centre by a bolt passing through the cross-girders. This bolt is adjustable, and the upper part is held by a very stiff spring in a state of compression, which spring is in turn supported by a wrought-iron saddle. The motor is then, so to speak, weighed or flexibly supported from the body of the truck. There is also a smaller spring to take up any back movement or tendency to lift of the motor. This suspension is directly in the centre of the pole-piece, and the field-magnets, which are grooved in the form of a circle, are independently detached from the pole-pieces, one of them being put on after the motor is in place.

The operation of this mechanical movement or method of mounting motors has exceeded the expectations of its designer. Because of the relation between the teeth in the pinion and the split gear, it is necessary for the armature shaft to make 66 revolutions before the teeth engage in the same way, and each tooth of the pinion must in turn engage every tooth in the gears. It will be seen, also, since the motor is suspended at one end by the truck axle and at the other by compression springs operating in both directions, that whenever the axle is in motion there is always a spring touch, so to speak, of the pinions upon the gears. Barring friction, a single pound of pressure exerted in either direction will lift or depress the motor a slight amount. It follows that no matter how sudden a strain, nor how great, it is impossible to strip the gears unless the resultant strain is greater than that of the tensile strength of the iron; because the moment that the motor exerts a pressure upon the gears, at the same instant do the spring supports allow the motor to rise or fall so as to give somewhat, and no matter how sudden the strain is brought upon the gears it is always a progressive one. The result in practice has been that with a weight equivalent to two tons upon each 30-inch wheel these wheels have actually been skidded in continuous rotation upon a dry track and the strain necessary to do this amounts to from 1,500 to 2,000 pounds upon each gear. Strain has also been put upon these gears as suddenly as it is possible to close a circuit across 600 volts, and without injurious effect.

This method of mounting motors tends to produce an absolutely perfect form of gear, and has practically obviated the noise which was at first anticipated.

Designs for motors of from 200 to 300 horse-power mounted on these same principles will soon be finished, and the motors constructed and put into operation.

We now come to the electrical features of the motor. The armatures shown in the drawing have a special modified form of Siemens winding. The shafts are built up of the finest forged steel, and the body of the armature is built up with alternating layers of tissue paper and very thin iron discs, such as are used in the Edison machine, which reduces the heat loss due to Foucault currents to a minimum. The difficulties first experienced in dealing with currents of such high electromotive force and large volume have now been overcome. The bodies of the armatures are thoroughly japanned and baked, and the utmost precaution is taken in putting on the different coils of wire to insulate them both from the body of the armature and from each other by the use of a material which offers very high resistance to inductive discharges. The commutators are built of the finest copper, and no insulating material is used other than that just mentioned and fine selected mica.

One of the fundamental features of this system of electrical propulsion is to get rid of all adjustments and to reduce it to the simplest possible system of working and at the same time to maintain as high an efficiency as possible of the motors themselves. For this purpose it was necessary, because of the limited space available, to make the motors of light weight and yet capable of developing a very intense magnetic field. The form adopted for these motors has given these qualities. The motors themselves are built entirely of the finest selected scrap iron specially forged. It was necessary further to have a wide range of speed under full potential at the armature terminals, and hence it was necessary, also, to have a wide range in the magnetic intensity of the field magnets.

A motor when acting in this manner is to be considered under three entirely different conditions:—

1. When it is at rest, and it is desired to get the greatest possible torque or tractive effort. This tractive effort should be under perfect control and should necessarily be greater than that which the motor could exert for any very long continued time.

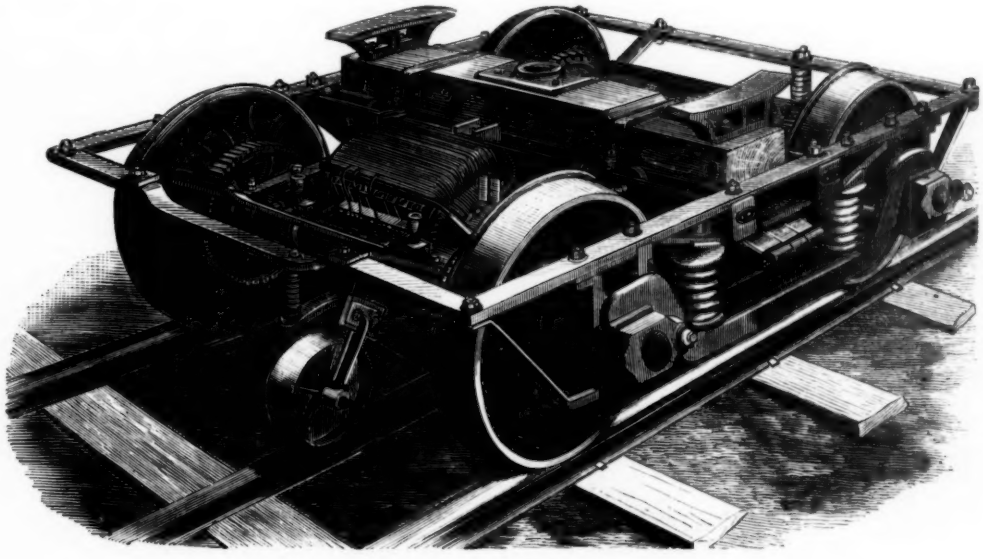
2. When exerting a continuous traction under accelerating speed. This is necessary in getting a train under way, and this effort ordinarily extends over the first third or half of its speed.

3. Variation in the speed of the armature after full potential has been reached at its terminals.

The first characteristic is obtained by bringing the field

magnets to a very high degree of saturation. Current is then admitted to the armature under perfect control, and the potential at the armature terminals gradually increased, thus increasing the current until the rotary effort is sufficient to start the train from a state of rest. When the motor is in this condition the torque, or rotary effort, is directly proportioned to the strength of the field magnet and to the current flowing through the armature. As soon, however, as the armature starts to rotate a different condition exists. It is now necessary to exert a continuous traction; but the motor, on account of its accelerating speed, is generating an increasing electromotive force of its own which is counter to that of the line, and the difference between this counter electromotive force and the line electromotive force determines the current through the armature. Consequently, it is necessary, while maintaining the field magnet at the same strength, to still further raise the potential at the terminals of the armature by means of which the current is kept at the same strength. It is impossible to maintain a constant tractive effort in any other way under these conditions. The potential will soon equal the initial, and the motor will be doing its maximum work per unit of time. It is now necessary to accelerate the speed of the train, and this is done by weakening the field magnets. This principle of weakening the field magnets to increase the mechanical effect of a motor at all times when not working up to the maximum was brought out by Mr. Sprague some time ago, when he enunciated the following principle :—

In a motor with the armature and field magnet independently supplied, the work which the motor will do in a given time, its economy and efficiency are all independent of the strength of the field-magnet, provided the translating devices intermediate between the motor and whatever is the recipient of its energy are not limited as to the rate of transmission of the motor speed; and



that in all cases where a motor is working on a constant potential circuit and not up to its maximum capacity, in order to increase the mechanical effect either of speed or power, or both, or to compensate for any falling off of the potential on a line, it is necessary to weaken the field-magnets, instead of strengthening them. The result is that, if running on a level at a certain speed and a grade is met, and it is desired to get up that grade at the same speed, it is necessary to weaken the field-magnets. If the potential falls off, and it is desired to keep up the same speed, it is necessary to weaken the field-magnets, and, conversely, if it is desired to slow down, it is necessary to strengthen the field-magnets.

A motor, when running, may be considered as a dynamo driven by a current. It generates an electromotive force dependent upon its resultant strength of field and the speed of the armature, and is independent of all other things. It follows that if the field-magnet be under proper control, this counter electromotive force is under perfect control under different speeds, and can be made greater or less in relation to the initial electromotive force, and consequently the motor can be made to do whatever work is desired of it.

This system of handling a motor, which is an essential departure from previous methods, has been carried out to its logical conclusion in braking the train, as will be indicated later.

The winding of the field-magnets of the motors is peculiar. One of the great difficulties which has invariably been met with in working with motors is the change of lead necessary to get the brushes at the point of non-sparking. It is absolutely necessary when dealing with large powers, if there is going to be continuous and successful running, to maintain the brushes at such a point. This change of the lead is caused by a distortion which is set up by the armature, varies with every change of load, with every change of the armature current, and with every change in the field magnet strength. It has furthermore been the habit where any considerable power has been developed to use two sets of brushes, one for forward and the other for backward motion. Mr. Sprague has entirely obviated the necessity for doing this by an arrangement which is as simple as it is efficient. This consists in the method of constructing, winding and connecting up the field magnets. The latter are wound with two sets of coils. One of these is a fine shunt coil which is in series with an independent regulating resistance and produces the normal poles; the other is a coarse coil in series with the armature which tends to produce poles at right angles to the normal poles, and this circuit is included in the reversing switch, so that when the armature circuit is reversed the current in the coarse coil is also reversed. There are then four poles set up in this machine, two being normal and variable at will, the other two being abnormal, variable poles dependent upon the current flowing through the armature.

In the normal arrangement of circuits, the two sets of field coils, fine and coarse, combine to set up a resultant polar line which is distorted or rotated in the plane of rotation of the armature. Since any increase in the armature current causes the same increase in the series field coils, the tendency to distortion by these two elements will always vary to the same extent, and the resultant position will be always the same no matter what is the extent of variation of current. If the strength of the field magnet is varied independently of the armature, by changing the resistance in the shunt field circuit or by a variation of potential on the line, while there is a tendency to change the armature distortion, there is an equal and opposite tendency to change the distortion due to the series field coils, and so this, also, has no effect. If the direction of the armature current is changed, so also is that of the current in the series field, and hence the direction of each distortion is changed; but they still oppose each other and vary equally and oppositely as before, and there is still no change in the non-sparking points. It is immaterial whether the change in direction of armature current is due to a change of terminals in changing the direction of rotation of the motor, or is caused in changing the motor into a generator by strengthening the field. Hence, the motor will run in either direction on a circuit of constant or varying potential, with a single or double set of tangential or end-contact brushes, with no change of lead, and, consequently, with no necessity for changing the position of the brushes. The position of the brushes having been once properly adjusted, it is made independent of the amount of work the machine is doing, or the speed at which it runs, or whether it is acting as a dynamo or as a motor. It is likewise independent of the strength of field and of the armature current so long as the magnetic moment of the field sufficiently exceeds that of the armature.

There are at each end of the car three vertical switch rods, each connected by movable links with rods running through from one end of the car to the other. These rods have projecting fingers which operate the levers of three very rapidly-moving switches; the movement of these switches is independent of the rapidity of movement of the hand, which simply stores up energy until a certain point is reached, when the lever is freed and the switch thrown over automatically. These three switches are employed as follows :—One for breaking the main circuit, another for reversing the armature circuit, and a third for detaching the armature partially from the line and closing it upon a local regulating apparatus. The movement of the handles on the vertical rods are similar at each end. Forward motion of one means forward movement of the car; forward movement of another means closing the main circuit; and a forward movement of the third means also a throwing off of the brake circuit. So that when a man stands at either end of the car, precisely the same movements means the same thing as he looks up the track. in

addition to these three vertical rods, there is a fourth rod which connects by a bevelled gear with a rod running through underneath the car, and provided with universal joints so as to allow of any necessary adjustment. The top of this rod carries a wheel very much like a brake wheel, and it connects with a regulator which consists of a series of resistance coils. These are so arranged that by the continuous movement of the regulator handle they are first cut out of the armature circuit, while the field is maintained at a high saturation, thereby raising the armature potential, and then cut into the field circuit in reverse manner, thereby weakening the field. This regulator governs also both steps of braking the train.

The current is taken from the centre rail by three conductors, two of which are bronze wheels working on pivoted arms under compression springs. They are provided with adjustable nuts to regulate the tension, and lock nuts to prevent the wheels dropping more than a certain limited amount when leaving the middle rail. The arrangement of contacts is such that the car will span 30 foot spaces without breaking the circuit. The other part of the circuit comes through the wheels of the truck, so that one part of the apparatus is continually grounded. The collector and the main circuit both run to fusible cut-outs before they reach the main braking circuit, and the armatures are also independently supplied at both ends with similar cut-outs. The armatures and the field magnets are all in parallel circuit with each other.

This is the first instance in which two independent motors have been simultaneously controlled from the same regulating source, and by the methods employed it is perfectly possible to control 20 motors in the same way. When it is considered that the speeds vary from zero to 1,200 revolutions a minute, and the speeds of the two motors should be the same, it will be seen how important a step has been taken. The torque or rotary effort of these motors under slow speeds is very great, and they are able to start from rest and propel two full-sized cars up the maximum grade on the elevated railroad. The motors weigh about 1,200 lbs. each.

We come now to the system of braking, which is the logical sequence of the system of controlling motors originated by Mr. Sprague. As is well known, when a motor is in operation it is generating an electromotive force. In other words, it is acting like a dynamo, and since this depends upon the strength of the field magnet and the speed, and since the field magnet strength is under positive control, it follows that this motor electromotive force can be made to equal the initial motive force and even to exceed it. When this electromotive force of the motor thus predominates, the machine will become a generator and give current to the line, and its mechanical effects are reversed so that it brakes the train instead of propelling it; and the current generated by it, and the braking power, or reversed mechanical effect, are now controllable by further increasing or re-diminishing the strength of the field, and the new dynamo can now be changed back into a motor instantly at will. The mechanical energy received by the reversed motor and delivered as electricity to the line depends upon the mass of the train and its velocity. In running on a down grade there would naturally be an acceleration of speed, but this method of braking can limit that acceleration at any desired point, or the motor can be slowed down when running on the down grade. This is done, of course, by strengthening the field magnets. Since the energy of the train is now being used to run the motors as braking dynamos, the train will be run at a certain constant speed down grade; or if the field magnets be still further strengthened, the train will slow down; this occurs also in the ordinary process of stopping. The diminution of speed, however, reduces again the motor electromotive force, and hence the field magnet has to be strengthened still further as a train slows, until the speed is reached which, with the strongest field magnet, will give a motor electromotive force equal to that of the line. This point with the motors in question is at about one-third speed, or seven miles an hour. Hence eight-ninths of the energy of a train moving 21 miles an hour is sent back to the line in current to relieve the generating station. In fact, the system as here set out has the advantages of a cable road, together with other advantages which the cable road does not possess; because not only do the trains running on down grades help the trains running on up grades, but those which are slowing down likewise give up their energy to the system. In fact, this system is one in which trains slowing down and running on down grades supply the current for trains running on up grades and starting, and the central station becomes a differential factor to make up for the loss of conversion and reconversion, and to provide for traction and loss in the conductors.

Were the machines perfect converts of energy, this would make the power taken by a system almost independent of grades and stops, and would simply be that necessary to provide for continuous traction and for loss on conductors. Of course, this perfection of conversion can never be reached. It does, however, make a difference of 40 per cent. in the power required to operate the electric railroads at the central stations, in the losses on conductors of a given size, and in the investment necessary in the central stations. As a matter of fact, there would be required at the central station only such horse-power as is to-day actually developed at any one moment on the elevated railroads, which is only about two-fifths of the capacity of the motors or engines.

Hence, instead of 7,215 ampères of current being supplied from the central stations at two points, it is supplied from as many additional moving stations as there are trains being checked on a down grade and stopping. Sixty per cent. only of this current would come from the main station; that is, 4,329 ampères, or 2,165 from each.

The final step of braking is done by partially detaching the armature from the main line when its motor electromotive force is equal to that of the initial, at which moment there is no current flowing through it, and closing it upon the same local regulating apparatus which is used for regulating the speed and power, and the first step of braking. By this means the train can be brought to a full stop. All these steps of braking are under the most perfect control, but if necessary the braking can be so sudden as to cause the wheels to have a continuous skidding rotation; not such a skidding as is caused when an air brake is put on too hard, but a rotating slip which will be just enough to relieve the armature when the strain on it has come to a certain point. This is the most perfect possible method of braking, because fixed skidding is an impossibility, and the wheels will turn until the train comes to a dead stop, although where the braking power is put on too suddenly and exceeds the grip of the wheels, they will relieve themselves by slipping just enough to keep the braking at the maximum limit.

With the switch in position for the last step of braking, the car can be allowed to creep down the maximum grades at a snail's pace with a movement so slow as to be almost imperceptible.

It is the customary practice to stop at the Second Avenue station of the elevated railroad station, which is on a 95-foot grade, without the use of any shoe-brakes, although the rear truck is fitted with these and can be operated at either end of the car.

By a slight reversal of the armature effort, the car will stand at a dead rest on this grade.

The energy of the train which is expended in the last step of braking can be used in heating the car, and some interesting experiments are now being carried on at the Thirty-fourth Street Station.

It should be noted that at present the generating station for this experiment is situated on Twenty-fourth Street, so that the current at times is carried about three-fourths of a mile. The proper electromotive force is obtained by coupling together five Edison machines in series. The wire used is No. 1 B. W. G., and is carried on the Western Union Telegraph poles. Mr. Sprague has by no means rested satisfied in developing his system of railway and carrying it to the advanced condition in which it now is, but he is now engaged in equipping the station and cars along the line of the road with Edison lamps, which are run in series from the same high constant potential circuit that supplies the car, on a system which has been developed by Mr. E. H. Johnson, the president of the company.

A *résumé* of the special and distinctive features of Mr. Sprague's system may not be uninteresting, and is therefore given below:—

A double-track system with motors working in parallel circuit with each other on a constant potential circuit, the two tracks being supplied from the same source and from the same main conductors.

A supply at two or more points by independent batteries of automatically non-sparking machines, the points of supply being maintained at the same differences of potential.

A system of continuous main conductors intersected by switches, and sectional working conductors connected therewith through automatic safety devices.

Means for cutting out, either automatically, in case of accident, or at will, if desired, any portion of the circuit.

An automatic block signal system for day and night use.

Methods for the equalisation of potential by cross connections between conductors of like polarity and on different tracks.

A very simple construction of the motor proper.

The centreing of the motor upon the axles so as to maintain parallelism between the driving shaft and the driven axle.

The method of flexibly supporting a part of the weight of the motor from the truck so as to allow perfect freedom in following the motions of the independent axles.

The method of doing away with all shock and jar and danger of stripping the gears, and the maintaining at all times of a spring touch so as to prevent any backlash and to ensure quiet running.

Double driving from opposite ends of the motor shaft.

The use of fixed and adjustable split gears.

The means for getting a very intense rotary effort in starting by having an intense magnetic field and raising the armature potential gradually.

The means for maintaining a continuous and equal traction until full potential has been reached.

The method of increasing or decreasing the mechanical effects, whether of speed or power, or both, by an inverse varying of the field magnet strength.

The method of controlling two or more independent motors simultaneously from the same source and by the same apparatus.

The use of a single resistance for both the armature and field circuits, each working independently.

The method of winding to maintain the point of least sparking at a fixed position, independent of the load, speed, or power.

The use of single sets of brushes for both forward and backward motion.

A system of braking consisting in converting the energy of the train into current, which is delivered back to the line through the same apparatus which propels the car without any reversal of contacts, whereby a saving of at least 40 per cent. would be effected in the size and capacity of the generating station, in the conductors, and in the coal and labour expended at generating stations.

The final step of braking by means of which the car is brought to rest through the same dynamic action of the motor while the field magnets are still connected with the line.

The method of lighting cars and stations from the main station.

The method of heating cars with a part of the energy of the momentum.

Such is the Sprague system as it is now being actively developed. It is the result of a long and careful course of study and experiment, and is justifying the confidence which has attended its progress.

It has received the most emphatic endorsement of one of the highest scientific authorities in the United States, that of Prof. Henry A. Rowland, of Johns Hopkins University, who closed a long report with the following significant statement:—

"Altogether, there is no doubt in my mind that Mr. Sprague's method of working motors for electric railways is thoroughly scientific, and that it has many advantages from a practical point of view. It is also decidedly more economical than any other that has been brought to my notice, and will certainly accomplish what is required in such a case, namely, the moving of a train of cars from one station to another in the least time, with a given maximum speed and with the greatest economy of power and least wear and tear of machinery."

It is a remarkable and unique fact that the Sprague enterprise has been, and is now, a private one.

The development of the railway system has been one branch of the work only, as the company has developed and has in wide use a variety of motors for transmission of power for stationary work.

The energy and confidence which have made Mr. Sprague's success possible are those of Mr. E. H. Johnson, and while the Sprague Company is regularly incorporated under the Manufactures Act of New York, it has not asked the public for one dollar of aid in its enterprise. Confident of success, this work has been carried forward to that point in which there can be no possible question as to its character. A system as important as that just described has, of course, been very thoroughly protected by patents, not alone in the United States, but many have been taken out also in England, France and Germany. Important developments are soon to take place as the result of the success with which this work has been attended, and the elevated railroads are as certain to be operated by electricity as the fact exists that there is such a force. It will not be a sudden change, but a progressive one, gradually adopted only as its reliability and success become apparent. Eventually, probably, there will be a four-track system on a part of the elevated railroads, in which two tracks will be devoted to express purposes, on which single cars will be run at high speeds and with few stops, as this necessity becomes more apparent with every increase in the population of the northern part of New York.

FIG. 2.

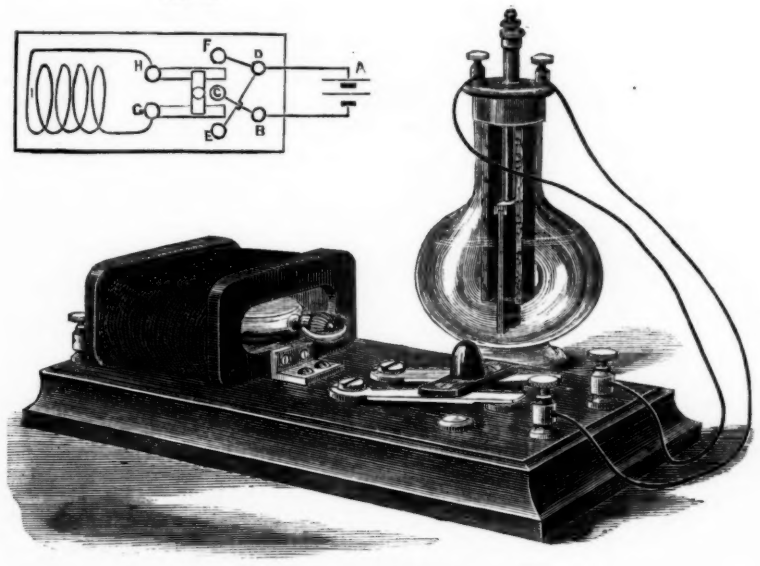


FIG. 1.—MACHINE FOR DEMAGNETISING WATCHES.

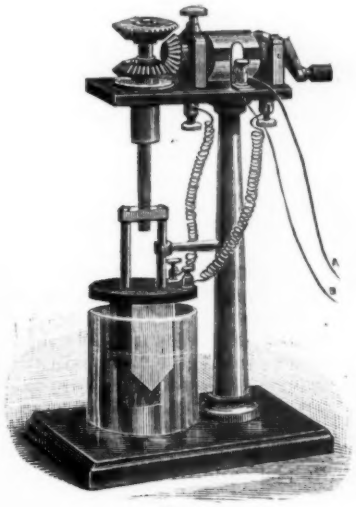


FIG. 3.

THE DEMAGNETISATION OF WATCHES.

THE chances of injury to watches by magnetisation have been greatly multiplied by the development of the dynamo and its extensive application to electric lighting and other purposes, so that it is very common to find magnetised watches in the hands of persons having no connection whatever with electrical matters. A watch readily becomes sufficiently magnetised to derange its action and render it entirely unreliable Proximity to a dynamo is not necessary to accomplish it.

The writer, Mr. Geo. M. Hopkins, in the *Scientific American*, after faithfully protecting a phenomenally accurate timepiece for years against the damaging influence of dynamos by leaving it behind while visiting lighting stations and other places in which heavy electrical currents were generated or used, suddenly found the watch behaving in a very erratic manner, gaining enormously one day and losing the next; but the strange action was not charged to magnetisation, as great care had been taken to avoid it. After a week's stay at the watchmaker's, the timepiece was returned to its owner, together with a bill of five dollars for demagnetisation. But for the undoubted integrity of the watchmaker, the bill would have been questioned. The remembrance of the free use of a permanent magnet about the time of the failure of the watch gave reasonable ground for the supposition that the watch might have received its magnetism from that apparently insignificant source. After demagnetisation, the watch ran well, but it soon suffered its former fate. This time, however, the watchmaker did not receive five dollars. The writer, knowing the cause of the trouble, effected a cure quickly and without expense.

The remedy in this case is administered on the purely homeopathic principle, *similia, similibus curantur*. If the watch is suffering from an attack of magnetism, magnetism must effect the cure, but much depends on how the curative is applied.

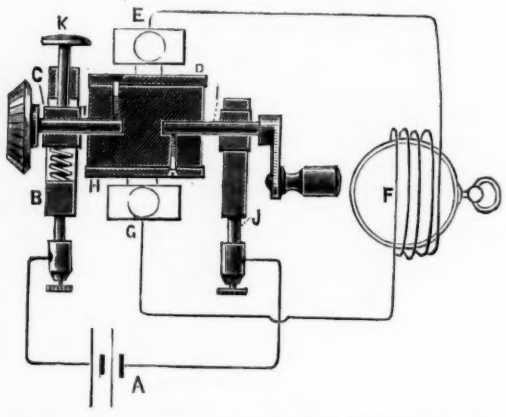
Fig. 1 shows simple apparatus for destroying the magnetism of watches. Fig. 2 is a diagram showing the electrical connections. Fig. 3 represents a demagnetising machine based on the principle embodied in the apparatus shown in fig. 1; and fig. 4 is a diagram showing the electrical connections of the machine.

The simple apparatus consists of a flat coil large enough to inclose a watch, a current-reversing key, or switch, and a plunging battery. One cell of Grenet battery is sufficient. The coil consists of about 225 convolutions of No. 18 magnet wire (Am. W. G.). Its longer internal diameter is $2\frac{1}{4}$ inches, its short diameter is $\frac{3}{4}$ inch, and its width is $2\frac{1}{4}$ inches. The resistance of the coil is $1\frac{1}{4}$ ohms. Referring to the diagram, Fig. 2, the terminals of the coil, I, are connected with the studs, G, H, on which are pivoted the switch arms. The switch arms are pivoted to a vulcanite bar, which maintains a uniform distance between them. To the base, and in the path of the free ends of the switch arms, are secured the contact buttons, E, C, F. The

middle button, C, is connected electrically with the binding post, B, and the outside buttons, E, F, are connected with the binding post, D. The binding posts, B, D, communicate electrically with the poles of the battery, A.

The watch to be demagnetised is placed in the coil, and while the switch arms are swung back and forth at the rate of about one complete excursion per second, the zinc of the battery is slowly plunged and as slowly withdrawn from the battery solution. When the switch arms touch the buttons, C, E, the current passes from the battery, A, to the binding posts, B, D, thence to the buttons, C, E, and through the switch arms to the studs, G, H, and coil, I. When the switch arms touch the buttons, C, F, the current passes in the reverse direction through the coil.

The success of the operation depends entirely on the regularity with which the current is reversed and the uniformity with which the zinc of the battery is plunged and withdrawn. A considerable pause of the switch arms on one pair of buttons will exhibit its effect in the preponderance of the magnetism, due to the continued flow of the current in one direction during the pause. An irregularity of this kind will necessitate beginning again.



ELECTRICAL CONNECTIONS OF THE DEMAGNETISING MACHINE.

The watch is tested to ascertain, in the first place, whether it is magnetised and in need of treatment of this kind, and afterward to determine whether the treatment was effectual by presenting its different sides to a compass needle or, better, an ordinary cambric needle magnetised and suspended by a single fibre of silk attached to its centre. The attraction of the needle by the watch is not positive evidence of its magnetisation; but if one end of the needle is attracted by one side of the watch and repelled by the other side, it indicates that the watch is magnetic.

The machine shown in figs. 3 and 4 has been devised to insure the regular reversing of the current and the uniform plunging and withdrawal of the battery zinc.

The zinc and carbon plates of the battery are suspended by a yoke which is engaged by a screw arranged to revolve in a sleeve supported by the vulcanite plate attached to the top of the column. As the screw is revolved in one direction on the other, the yoke travels up or down on the screw, carrying with it the plates of the battery.

To the screw above its journal are secured two bevel wheels, either of which may be engaged by the pinion on the swinging horizontal commutator shaft.

The commutator is of the kind commonly used on induction coils. It consists of a cylinder of vulcanite mounted on a shaft divided in the middle into two halves, C, I (see fig 4), and having on diametrically opposite sides curved metallic plates, D, H; the plate, D, communicating electrically with the part, C, of the shaft, the plate, H, communicating with the part, I. The shaft, I, is journaled in a box pivoted in the standard, J, and is provided with a hand crank at its outer extremity. The shaft, C, which carries the pinion, is journaled in a spring-supported box arranged to slide in a mortise in the standard, B. The spring-supported box is provided with a knob, K, by which it may be depressed. Springs, G, E, which press opposite sides of the commutator cylinder, communicate electrically with a coil, F, like that already described. The current flows from the battery, A, to the standard, B, thence through the shaft, C, plate, D, spring, E, coil, F, spring, G, plate, H, shaft, I, and standard, J, back to the battery. By pressing down on the knob, K, the pinion is brought into engagement with the lower bevel wheel on the screw.

If the crank be turned, the battery plates will be gradually lowered; at the same time, the direction of the current through the coil will be regularly reversed by the commutator. When the plates have been plunged sufficiently, the knob, K, is released, when the spring raises the commutator shaft and brings the pinion into engagement with the upper bevel wheel, and the screw is turned in the opposite direction gradually, withdrawing the plates from the battery solution.

To cause the solution to readily leave the zinc plates, they are made angular at their lower ends. This device also diminishes the strength of the current as the zincs are withdrawn. The connection between the battery and the standards, B, J, is made by means of spirals to permit of the free movement of the battery plates. The binding posts attached to the commutator springs are connected by wires, A, B, with a coil like that shown in fig. 1.

If the first treatment of a watch does not entirely demagnetise it, the operation should be repeated without plunging the battery plates deeply.

REVIEWS.

The Laboratories of Electro Technics, and their Novel Appliances ("Die Laboratorien der Elektrotechnik und deren neuere Hilfsapparate"); *A Manual for Electricians, Mechanists, Telegraph Engineers, and for Teachers and Students of Physics.* By AUGUST NEUMAYER. Vienna, Pesth, Leipzig: A. Hartleben.

The progress of electricity is strikingly manifested in the development of the localities for its study. In old works we read sometimes of "physical cabinets," where electric, magnetic, acoustic, thermotic, and optical apparatus such as then procurable, were stored up rather as curiosities than as instruments for general use. Next we find electrical apparatus—especially galvanic batteries and their accessories—finding hospitality in the chemical laboratory. A further step is the chemical laboratory arranged for research in every department of physics, and lastly we arrive at our author's subject—a laboratory specially equipped for the study of electricity and magnetism. It is very doubtful whether such special laboratories would have been required, had it not been for the practical and industrial development which the study of electricity has latterly taken. The necessity for a treatise like that before us will be at once recognised, if we remember that both the quantity and the accuracy of the work which can be got through in a given time depends greatly on the arrangement of the necessary apparatus. In every department of the physical and natural sciences an ill-planned laboratory proves exceedingly costly.

Herr Neumayer describes, in succession, the reading-telescope, in its several modifications, the electrometers of Sir W. Thomson, of Mascart, Nöhrer, Ponscy, Edelmann, the batteries for charging electrometers, the absolute electrometers of Sir W. Thomson and Minchin, and various galvanometers. Next come the sources of currents, including dynamo-machines, thermo-columns

and batteries, among which latter those of Daniell, the chromic acid elements, the normal elements of Latimer Clark, Lodge, and Kittler, and batteries for the measurement of cables are particularly described. The following chapters treat of measuring-bridges and resistances, of commutators, clamps, conductors, voltameters, and the secondary appliances of the laboratory.

Laboratories on different scales of completeness and size are described as suitable for a mechanician, for a practical electrician, for a private scientist, or for a university or a technical high school. Specially modified laboratories are described as requisite in manufactories of dynamos, in central telegraphic and telephonic establishments, for the study of atmospheric electricity, and for observations on terrestrial magneto-electric phenomena.

The work before us fills up an important vacancy in the literature of electricity, and must therefore be pronounced welcome.

Electricity and Magnetism in Antiquity. (Electricität und Magnetismus im Alterthume.) By Dr. ALFRED RITTER VON OHBANITZKY. Vienna, Pesth and Leipzig : Hartleben.

The mere routine practitioner, and even the inventor are, as such, not always concerned about the amount of knowledge possessed by their forerunners nor about the manner in which it has been reached. Hence we can well imagine that the work before us will, in some quarters, be laid aside with indifference. But the man of broader views will often find it a pleasant and not unprofitable task to review the steps by which our present position in any department of science has been gained. All such persons will, therefore, feel indebted to Dr. von Ohbanitzky for the laborious investigation which he has undertaken, and will congratulate him on the very successful manner in which he has carried out his plan. He appears to have consulted every passage in the authors of classical antiquity in which electricity or magnetism is referred to. The Edda has been laid under contribution and Chinese authorities are freely quoted.

A much more difficult task has been to weigh the facts thus accumulated and to ascertain precisely what the authors understood by the language they used. Here Dr. von Ohbanitzky has had to steer clear of a two-fold difficulty. On the one hand is the notion, dominant until about a century and a half ago and which in some quarters shows symptoms of reviving—that the ancients knew all that we know and a great deal more. On the other hand is the creed of the friends of "progress" such that the said ancients, though inimitable in the fine arts, were literally nowhere as far as science and industry are concerned. Between these two exaggerated and one-sided views our author takes the golden mean. He admits that antiquity laid the foundations for our present extended and extending knowledge. To us, these foundations may sometimes appear insignificant. But we can make the more rapid advances as they have saved us the trouble of taking the first steps ; they have left us their observations and their very errors have aided us in discovering and utilising the treasures which they never possessed, the inductive method and the systematic interrogation of Nature by experiment.

Perhaps it might have been well if Dr. von Ohbanitzky had searched through that relic of the wisdom of Egypt, the *Papyrus Ebers*, dating back to the 15th century before the Christian era, and the *Book of the Balance of Wisdom*, due to certain Arab sages of about A.D. 1100. These two works written at intervals of more than two thousand years apart prove that in the East, though not in Europe, science was being cultivated substantially in the same spirit and by the same methods as in our day. It is exceedingly probable that references to magnetism and electricity may be found in these works. We should like also to direct the attention of Dr. von Ohbanitzky to certain statements made by Mr. Sinnett and Madame Blavatzky that certain Buddhist recluses "understand more about electricity than Faraday, more about physics than Tyndall." Our own opinion, so far as we can form one from the fragments of Occult lore which have fallen into our hands, is decidedly unfavourable to these high-flown claims. But we hoped to have seen them scrutinised by the author of the work before us.

We certainly do not think, as he appears to do, that in antiquity there was any regular and continuous advance in physical science, or that the palmy days of the Roman Empire were those which most nearly approached our own as far as a knowledge of nature is concerned.

Dr. Von Ohbanitzky discusses in this treatise the names and varieties of the lodestone as known of old, magnetic phenomena and the theories proposed for their explanation, the compass, and the discovery of declination and inclination.

Turning to electricity he examines the electron of the ancients, the locality of amber, its origin and its properties. The aurora borealis comes next under consideration, a phenomenon first mentioned by Aristotle in his "Meteorologica." His description decidedly refers to the Northern Lights, though he makes no mention of the quarter of the heavens where this display is seen. Like the subsequent writer, Cicero and Seneca, he does not seem to have clearly distinguished the aurora from the zodiacal light, the tails of comets, and from showers of meteors.

Lightning and St. Elmo's fire were the subjects of special observation in antiquity, not from a purely scientific point of view, but from that of the soothsayer. Sheet-lightning was clearly distinguished from ordinary lightning. The rare phenomena of globular lightning (the éclairs spherique of Arago) and lightning striking upwards from the earth, were also observed and recorded. It was at an early date recognised that lightnings do not always reach the earth, but strike sometimes from one cloud to another. Meteoric stones seem not to have been clearly distinguished from lightning and its effects.

A curious question is raised whether electric storms were possibly more frequent and more violent in ancient times than we now find them ? Arago is quoted as pointing out that in modern times no man of eminence or position has perished by lightning, whilst in antiquity a number of kings, generals, &c., were thus destroyed.

In the last chapter of the work the author discusses the myth of Castor and Pollux, the alleged electric apparatus and lightning-rods of the ancients, and the antique representations of lightning. He rejects as fabulous the tradition that Numa possessed the power of conducting the lightning harmlessly to the earth and of directing it at pleasure, and that his successor, Tullus Hostilius, repeating his performances without the due knowledge, was struck dead.

It was held that persons might be protected against lightning by wearing the skin of a crocodile, a hyena, or a seal, and by putting a wreath of laurel on the head. Had anything like the lightning-rod been known, we can scarcely suppose that such childish means of protection would have been employed. Electricians will find this little book worth their attention.

Post Office Telegraphs. Connections of Telegraph Apparatus and Circuits. General Post Office.

This book (which we have received from the Secretary of the General Post Office) was, we believe, in the first instance, originated in the Royal Engineer Division of the Postal Telegraph Department, a number of explanatory diagrams of connections, &c., in a book form having been issued semi-officially for the use of the division in question. An enlarged and revised copy of this production was subsequently issued for the general use of the whole service ; the present book may be regarded as a more complete edition of the latter. The work contains 59 plates, showing the connections of every kind of instrument in use in the

Postal Telegraph Service, with brief explanatory notes on the same. Owing to the varied requirements of the Postal Department, the necessity of a book of the kind is obvious, as even the best memory may be at fault sometimes when an instrument is to be joined up or a defect traced. An idea of the complicated nature of the connections in some of the apparatus may be gathered from a glance at the plate representing the fast speed duplex and single repeater.

The volume is of a very convenient size, and the various diagrams, although in some cases necessarily rather cramped, are always clear.

NOTES.

The Electric Lighting of Wentworth Castle.—The electric light fittings for the installation at Wentworth Castle, which we described a fortnight ago, were designed and manufactured by Messrs. Faraday and Son for Mr. Hartnell, who carried out the installation.

Electric Lighting at Great Grimsby.—The first installation of the electric light in this town has just been made at the factory of the Great Northern Ice Company, Limited, Freeport Wharf, Great Grimsby, by Messrs. Swete and Main, electric light contractors, of Queen Victoria Street, London, under the personal supervision of the company's chief engineer, Mr. E. H. Tompkins. The installation is on the incandescent principle, and consists of 25 Swan lamps of 16 candle-power, each being fitted with a cut-out and switch. The dynamo is one made by the late firm of Oppermann Brothers, and is driven direct from a 6 H.P. horizontal steam engine, which is also used for driving a set of ammonia pumps against a pressure of 180 lbs. on the square inch, the engine running at 100 revs. per minute. The installation is a great success, and is interesting as being, we believe, the first utilisation of the electric light in an artificial ice factory.

Electric Lighting at Burnley.—In connection with the visit to this town of Prince Albert Victor for the purpose of opening the New Victoria Hospital, a considerable installation of the electric light has been carried out in the streets by the Gülcher Electric Light and Power Company. Twelve 3,000 C.P. arc lamps are arranged symmetrically down each side of the main street. One of these lamps is suspended from a large jib crane over the new Municipal Buildings. A triumphal arch in Manchester Road is surmounted by a search light of 10,000 C.P., which throws a beam of light two miles in any direction. This installation has been carried out to the order of the Corporation of Burnley; but the inhabitants of the town have shown great public spirit by largely contributing to the illumination by privately adding to the number of lamps. In the Market Place, two 2,000 C.P. arc lamps have been erected by subscription; and in the same way three similar lamps have been erected in St. James's Street. Messrs. Grimshaw and Hargreaves have together put down a separate installation consisting of a No. 2 Gülcher dynamo, two 2,000 C.P. arc and thirty 20 C.P. incandescent lamps, the lamps being tastefully arranged around the triumphal arches in Church Street. The Mayor and Mr. Councillor Bailey have each a powerful arc lamp in front of their houses. The Mayor's lamp is worked by a separate dynamo driven by a small horizontal engine and vertical boiler in his own garden. The main lighting is maintained from a 5 A Gülcher low-tension dynamo, driven by a Marshall's 14 horse-power compound portable engine. Thirty-five H.P. (actual) are absorbed at the dynamo, for which a total light is obtained equal to 55,000 to 60,000 candles. Although heavy rain was falling almost incessantly nearly every day, the whole of the work has been completed in five days.

Thomson-Houston Electric Lights.—The Thomson-Houston Electric Company made the following magnificent output of its arc and incandescent systems during the month of September:—Arc Lights:—Montpelier, Vt., 30 new; Salem, Mass., 120 increase; Brooklyn, N.Y., 45 increase; Carnegie Bros., Pittsburgh, Pa., 66 new; Hoboken, N.J., 45 increase; Turner's Falls, Mass, 30 new; Amoskeag Mfg. Co., Manchester, N.H., 45 new; Fitchburg Worsted Co., Fitchburg, Mass., 30 increase; Rutland, Vt., 45 increase; Mobile, Ala., 45 increase; Lafayette, Ind., 45 increase; Adrian, Mich., 45 increase; Danville, Va., 30 increase. Incandescent Lights:—Norwich, Conn., 300 new; Bangor, Me., 300 new; Asa Cushman & Co., Auburn, Me., 600 new: Day Cordage Co., Cambridge, 50 new; Webster and Bond, Dodge City, Kan., 250 new; Woonsocket, R.I., 300 new; Terre Haute, Ind., 600 new; Mahoning Valley Iron Company, Youngstown, O, 200 new.

The Telephone in the North.—The Northern District Telephone Company is still adding to its already extensive system of trunk wires. On Monday last a new line connecting the Durham Exchange with those at Sunderland and the Tyneside, was completed with great success by this enterprising company, which intends to extend its wires as soon as possible to Blyth. Durham is now brought into communication with Middlesborough, Stockton, Hartlepool, Darlington, Sunderland, and the Tyneside, and when Blyth is also connected with these towns, a vast field for telephone enterprise will be opened to the company, as both Durham and Blyth are thickly surrounded by collieries, and these require ready communication with their head offices, and this the company will now be able to provide.

Action respecting Telephones.—On Monday, at Clerkenwell, Mr. Eddis heard a case in which the Stanhope Company sued Messrs. Russell and Hope, of the Cardiff Exchange, for £24 16s. 8d., value of a number of "Byng" telephones supplied. The contention was that defendants were made agents for the machines in South Wales on the understanding that they purchased 50 sets, but on the part of the defendants, it was urged they were only agents to take the goods on sale or return. It was also suggested that the machines did not act well; but Mr. Sawry, managing director of the Stanhope Company, said his firm had fixed hundreds of the machines in the Bank of England, the Houses of Parliament, and other institutions and offices in London, and they had worked successfully. Mr. Crispe was counsel for the plaintiffs, and Mr. Corrie Grant for the defendants. Judgment reserved.

Telegraph Revenue.—The receipts on the telegraph service from April 1st to October 16th, 1886, amounted to £1,015,000 against £1,010,000 received from April 1st to October 17th, 1885.

The Gale and the Brighton Electric Railway.—During the severe gale which swept over the south coast and other parts of the country last week, the electric railway, which Mr. Volk has so successfully conducted at Brighton for some time past, was reduced almost to a wreck on Friday. The storm alighted with great violence on the east part of the town, and between the Aquarium and the Chain Pier where the railway runs the wind developed into a perfect hurricane. The railroad lies on raised ground above the beach and below the road. During the morning huge breakers swept against the beach and carried away the foundations of the railway, and in some parts the rails were rent from their horizontal position and twisted into corkscrew shape. By the evening the storm had by no means abated, and it was greatly feared that the railway would sustain further havoc. During the afternoon the metals which had been torn up were either lashed to the Esplanade or removed altogether. In the night the sea beat with the most intense fury against the beach, and the large foam-tipped breakers washed over the electric railway and flooded the road.

The whole of the railway supports were in some parts destroyed, and ropes had to be used to secure the railway metals and the longitudinal sleepers. Ultimately the depredations of the sea were so great that only a foot of beach remained, and Mr. Volk's waiting rooms near the Aquarium were in imminent danger of being washed away. Large crowds of persons assembled to witness a scene which has not been equalled for grandeur for some years. A large outlay will be involved for the purpose of putting the railway into working order again, but Mr. Volk, who has met with a similar misfortune before, although the consequences were not so serious, will no doubt be equal to the emergency.

Mr. Volk writes to the *Standard* as follows :—"In the able article in the *Standard* to-day *re* the storm at Brighton, you demolish my electric railway altogether, and that is more than the sea has done. Only a short length is displaced, and some beside undermined, but £150 will set matters right, and I hope the cars will be running all the way by Monday next. As we have visitors often coming to Brighton to see the railway, the report that it is gone is likely to injure the undertaking, which up to the present has been a great success."

Telegraph Plant in Canada.—The metallic telegraph poles patented by F. N. Gisborne, C.E., electrician and general superintendent of the telegraph service, have been adopted by the Canadian Government, who are now having several thousand of them erected across the North West prairies between Battleford and Edmontoro. These poles were manufactured for the Government by Messrs. Clark, Muirhead & Co., of London, and are described in the "Abstracts" of Patents in our issue of September 24th last. Mr. Gisborne's porcelain insulators have also been adopted, after trial, both by the Government and by the Canadian Pacific Railway Company, a great many thousands of them being now in effective use. Samples of both these and other inventions of Mr. Gisborne's can be seen at the Colonial and Indian Exhibition, and merit an inspection for their practical utility.

The Liverpool International Exhibition.—The Globe Electrical and Engineering Company has been awarded a silver medal at the International Exhibition at Liverpool for electric lighting appliances. At the company's stand are exhibited the Cruto lamp lighted by a Manchester dynamo, and Hedges' patent speed indicator at work.

The Distribution of Power.—We quite agree with M. H. Serrin (whose letter we publish to-day) about the necessity of proving the advantages of electricity for distributing power. The article referred to in the *Génie Civil* gives a comparison between four different systems : electricity, hydraulic power, compressed air, and the tele-dynamic cable. The latter is the cheapest for short distances (say, under one mile), but would not be applicable, especially in a town, for a distribution over a large area. The author is strongly in favour of electric distribution ; hydraulic power and compressed air are more expensive, the installation and repairs in case of leakage are, for these two systems, extremely difficult, and very often in winter, with hydraulic power, the work must be stopped on account of frost. We shall endeavour to refer more fully to this matter in a future issue ; if possible, in our next.

Gas Explosion in a Theatre.—An explosion occurred in the gas room at the Theatre Royal, Leicester, on Tuesday. and resulted in somewhat serious injury to a woman, as well as in blowing out two windows of the theatre. The explosion was due to the bursting of some gas pipes connected with the receiver for the limelight.

Fatal Electric Shock.—Rhody Carroll, an employé of the Western Union Telegraph Company, was fatally injured at Detroit from a shock received from a wire of the electric light company.

Electric Light Semaphores.—The Admiralty is about to despatch a flotilla of gun vessels and coastguard cruisers, consisting of the *Avon*, *Forester*, *Firm*, *Cherub*, *Amelia*, and *Argus*, on a cruise in the English Channel to test the new electric semaphores for night signalling, with which these vessels have been fitted. The experiments will be made under the superintendence of Admiral Sir William M'Dowell and the members of the Signalling Committee.

A Sad Occurrence.—On Tuesday morning, at half-past eight, Police-constable 104 G, whilst on duty at King's Cross Station, had his attention called to a respectably-dressed man lying in a doorway in the Caledonian Road, and on proceeding there he found that the man was in an unconscious condition, but from what cause he could not ascertain. Without delay he had him removed to the Royal Free Hospital, Gray's Inn Road, where, on his being examined by Dr. J. Orford, the resident medical officer, life was found to be extinct. On the body being removed to the hospital mortuary and a search of the clothing being made, a number of papers were found, from which it is believed that the deceased's name is J. C. Amis, an electrician, in the employ of Messrs. Dale, of Ludgate Hill.

Patent Claims.—Mr. Rawson in the course of his speech last week at the Cannon Street Hotel spoke of the American system of making as many claims as possible in a specification for reasons which he set forth. It would be interesting to peruse the claims of Mr. Sprague for electrical propulsion, for if they are at all represented by the *résumé* of the special and distinctive features of his system given on p. 402, we should think there will be plentiful occasions for disclaimers.

Petroleum Engines.—We understand that the Etève-Humes motor is now being actuated by means of ordinary paraffin, which has been substituted for the more dangerous oil hitherto employed. The cost of working is not only less, but the difficulties attendant upon the storage of oils with a low flashing point are overthrown.

More Litigation Probable—The lawyers are, to use an Americanism, having a "high old time" amongst the electrical fraternity. Electric traction appears to be the latest peg upon which to hang a lawsuit, although the new method of locomotion has scarcely yet got under weigh.

Our Correspondence Columns.—Owing to the number of letters sent to us for publication this week, we are compelled to hold over an interesting illustrated article upon a matter which will probably demand attention in this country sooner or later. This will, however, appear in our next issue.

Electric Light Rivalry in America.—The New York *World* recently contained the following :—"There has always been sharp rivalry between the several electric light companies, but the war waged between the American, of this city, and the Thomson-Houston, of Boston, has been conducted with unusual ferocity. It has reached a point at which, as will be seen by the announcement in to-day's *World*, the New Yorker boldly challenges the Bostonian to a test of the respective merits of the two systems. As the forfeits are to go to the Charleston sufferers we are disposed to urge the Thomson-Houston and all other companies to promptly 'put up or shut up.' The American Company, which issues the challenge, is the one which Gen. Stone and the Lighthouse Board have selected to light the torch of Liberty. Mr. Goff, the president of the company, on being informed that his proposition to supply the apparatus had been accepted, emulated the example of the *World* and made a gift of it to the Government."

Unfair Competition.—Written for American readers, the following editorial of our namesake in New York is remarkably applicable over here just now: "It certainly cannot result to the advantage of any electric light company, incandescent or arc, to make a business of contracting to put in plants for less than cost. Such methods are not only demoralising to electric lighting from a commercial standpoint, but are sure to result disastrously to their authors."

His own Enemy.—The New York *Electrical Review* says:—"There is a stockholder in an electric light plant in Chicago who will not permit his own company to run a wire through his premises."

An Effect of D.T.—In the *Daily Telegraph* of Thursday morning we observed the following item from the Paris correspondent of that journal:—"A peculiar and serious accident happened last night in the Grand Hotel here. The generating tube of the electric light machine burst, owing to want of water, and two of the men tending the apparatus were seriously scalded by the steam." We do not see anything peculiar in this. If the two men had burst owing to want of steam, or if the apparatus had been seriously scalded from want of water, or if the electric light machine had burst up the generating tube of the *Daily Telegraph*—there might have been something in it.

Personal.—We hear it rumoured that Messrs. Drake and Gorham have the intention of going into business as manufacturers of secondary batteries, but we do not place much credence in the statement.

A Projected Installation.—We understand that Messrs. Collinson and Lock, of Oxford Street, intend lighting their establishment with the electric light. The business of the firm is that of art decorators and furnishers, and we are informed that after a trial of the Wenham gas lights these have been rejected in favour of electricity.

A Glasgow Jubilee Exhibition.—Glasgow, determined not to be forestalled by either Manchester or Newcastle, is announcing a Royal Jubilee Exhibition to be opened on 25th November and closed on 31st January. It is to be electrically lighted "with lamps never before introduced in Glasgow," by Messrs. Norman and Son.

The Proposed Littlehampton Electric Railway.—On Monday the question of the desirability of establishing an electric railway at Littlehampton was discussed at a meeting of the Local Board, when Mr. Volk attended for the purpose of requesting permission to carry out that enterprise and also to build a pier. Plans were produced by Mr. Grantham, C.E., on behalf of the applicant, showing that the proposed pier would contain a station at the entrance for the electric railway, which would run from the railway station along High Street, Beach Road, Augustine Terrace, and about three parts along the South Terrace, when it would turn down the road leading to the Esplanade and finish at the pier entrance. Considerable discussion followed, but although great doubt was cast on the likelihood of the pier succeeding, there was a strong feeling pervading the Board that the electric railway would be a great attraction to the place and would pay a good percentage. Eventually it was resolved, with only two dissentients, that Mr. Volk should be accorded permission to carry out his scheme, the cost of which was estimated at £12,000 or £13,000, of which £3,000 or £4,000 would represent the outlay for the railway.

Telegraph Poles.—The Postmaster-General invites tenders for the supply of 4,900 red fir telegraph poles, to be delivered in London, and 12,020 to be delivered in Northumberland Dock (River Tyne) or West Hartlepool. Particulars and forms of tender may be obtained of Mr. W. H. Winter, controller of stores, Telegraph Street, London, E.C., and tenders will be received until noon on November 1st.

The Pollak Battery.—In the REVIEW for July 30th last we gave an illustrated description of this cell including a curve which graphically represented its performance over a period of nearly 700 hours. The particulars of its construction, action, electrical constants, &c., were fully dealt with, and it is therefore unnecessary to refer again to technical details. The Pollak battery has been introduced into this country by Messrs. G. Binswanger & Co., who recommend it as suitable for a great variety of purposes including electric lighting. In this latter respect, however, it is not intended to compete in any way with existing apparatus as a means of permanent illumination, but only where intermittent lighting is required, as for example, in reading lamps and the temporary illuminating of cellars, staircases, offices, stables, &c. For telephonic and telegraphic purposes it appears to be eminently suited, as constancy to a remarkable degree is one of its main features. During the week we have seen the Pollak cells in the establishment of Mr. Binswanger, where electric incandescent lamps and other apparatus to be used therewith are in daily operation. We think Mr. Binswanger is wise in limiting the employment of the battery to intermittent lighting only, and for this purpose the cells will remain in good condition for a great length of time without attention. In fact they will give as little trouble as do Leclanché's piles when used for ringing electric bells. The claims put forward on behalf of the invention are modest and reasonable; the materials consumed are zinc and sal-ammoniac, no acids are employed, no fumes emitted, and no attention is necessary except at long intervals. We think, however, that "self-charging" is a misnomer and apt to mislead the public, and we should like to know whether after a long period of rest the copper with which the carbon electrode is coated will not be found deposited upon the zinc? We would advise all who are interested in batteries to call and see the Pollak cells for themselves, for at Mr. Binswanger's place, at least, everything is free and open to the inspection of enquirers. No secrecy is requisite through the incomplete state of foreign patents, no mysterious alloys or potent liquids are hinted at, and we are not treated to a discourse on the precious value of bye-products, by the sale of which when we have found a purchaser, we are enabled to have our electrical supply for nothing and a handsome source of income into the bargain. Here, indeed, we have something which is intended to meet certain supposed requirements, and if a fair amount of success be not obtained, the fault will not rest with the battery, but will be due to the fact that the public wants have been misunderstood.

The Etève-Humes Petroleum Engine.—An ordinary general meeting of the Self-Propelling Motor Syndicate was held last week, when Mr. E. Morton, who presided, gave a favourable statement as to the working of this engine. Reference was made to the great services rendered to the syndicate by Mr. Humes, without whose aid the engine would never have been in its present condition. The capital of the company was increased to £25,000 by the creation of 1,000 new shares of £5 each.

Lighting the Statue of Liberty.—It is stated that General Charles P. Stone, who, until the Government took charge, was the engineer directing work on the Bartholdi statue, has, after much investigation, recommended a system of electric lighting for the unique lighthouse, and that his recommendation has been approved by the Government officers. The apparatus to provide the light consists of one dynamo complete, 13 duplex-arc lamps, and 14 50-candle-power incandescent lamps. The torch will contain five lamps of 30,000 candle-power, the light from which is to be thrown upward. It is predicted that the lights will so illuminate passing clouds that they will be visible 100 miles or more. Four lights of 6,000 candle-power each go at the foot of the statue for its illumination. Incandescent lamps fixed in the diadem on the figure's head will lend the appearance of jewels. The system

to be used is the American, and the American Electric Manufacturing Company intends to make a gift of the apparatus for the purpose.

Electrical Conductors in New York.—In the State of New York all wires were to be put underground by November 1st in all cities of 500,000 inhabitants and over that number. That time having been found insufficient, it has now been extended. In the city of New York alone, 388 miles (237 miles of telephone wires, 72 miles of telegraph wires, 22 miles of wire for the electric light, and 57 miles of wire for fire alarms) have up to the present time been put underground. There remains to be so placed in New York :—2,098 miles of telephone wire, 2,302 miles of telegraph wire, 166 miles of wire for the electric light, 423 miles of wire for the messenger service, 150 miles of wire for the service of the Exchange, 115 miles of wire for various purposes, 23 miles of wire for the service of the police, and 327 miles of wire for the fire alarms—total 5,604 miles. When all these wires have been placed under ground, New York will have close upon 6,000 miles of subterranean cables.—*Morning Post.*

An American View of English Electric Lighting.—Says the New York *Electrical Review*, "A gentleman well know in scientific circles lately returned from Europe, in speaking of the relative progress of electric lighting in England and the United States, expresses the opinion that while not much has been done on a large scale in the way of installations for general distribution of electric currents in the cities and towns of England, still the growth is an extremely healthy one. The number of installations in private residences is extremely large. Especially successful are numerous storage battery plants, the motive power for the dynamo being usually a gas engine. It is a matter of regret that more attention has not been given in this country to domestic incandescent installations."

French Atlantic Cable Company.—The general meeting of this company took place recently, and a large number of shareholders, representing 44,366 shares, attended. Before the opening of the meeting Mr. Barbe, one of the directors, announced that the board would resign after the voting of the first two questions, which were "approval of the accounts" and "declaration of a dividend of 5 francs per share." Mr. Pouyer-Quertier declared the meeting open, and the business was proceeded with. Mr. Rossignol read the auditors' report, after which the meeting proceeded to vote the first two resolutions. The first one was carried by a very small majority; the second resolution was voted by a larger majority. The president then declared that the entire board now resigned. It was evident, says the *Moniteur de la Bourse*, that the members of the board, who had met before the meeting, at their offices, Rue de Chateaudun, with the group of shareholders they thought they could depend on, had seen that they were in a minority and that they wished, in acting thus, to elude the vote on the third resolution, which was "Dismissal of the present directors." The meeting was good natured, and instead of refusing this resignation, given after the failure of the manœuvres of the last moment, and proceeding to the dismissal, contented itself, after a long discussion, with purely and simply taking note of this resignation, without, however, giving the resigning directors their discharge. When Mr. Barbe made his declaration, the largest shareholders met together and composed a list of new directors to be elected, called "The Conciliation List," taken one-third from amongst the members of the old board, and two-thirds from amongst the principal shareholders present. Everything seemed settled, and they were about to commence voting; but yet another surprise was reserved for the meeting. At the request of a shareholder the entire board, with the exception of the Count de Valon, announced that they submitted themselves for re-election. A scene of great confusion then took place, followed by an indescribable tumult, each one wanted to speak, as always happens on such occasions. Discussions arose in every part of the hall between the indignant shareholders and the friends of the old directors, and no orator could make himself heard. The president even had, at a certain moment, to threaten the shareholders that he would dissolve the meeting. This threat produced its effect, because both sides wanted to terminate the affair, and the meeting became sufficiently quiet to enable the chairman to ascertain that the majority of the meeting wanted no more surprises in the putting of the votes, but intended to vote on this important question by a strict scrutiny of the shares. This took a long time, but the board's manœuvre was frustrated, and "The Conciliation List" was voted by a majority of 307. "We could not keep our countenance," continues the *Moniteur*, "on seeing the discomfited physiognomies of the representatives of the English companies, who had been allowed to believe that their presence was necessary in order to ensure a majority. They had bought 400 shares each, and had come with the positive certainty of outwitting these good Frenchmen. They have lost their money, and will see, or at least we hope they will see, that the present board will not accept their proposals with the same readiness as the former one did."

Galvanometer Needle.—Writing to *Industries*, Mr. R. Snowdon says :—"Presuming that it may interest the electrical section of your readers, I should like to describe a device—novel, as far as I am aware—which I have tried with success, for supporting the needle of a tangent galvanometer. A small dish, A, 1 inch diameter, with sharpened edges, *a*, *a*, is filled with clean water, and a needle, N, made from the hair spring of a watch, is cemented to the top of a small cylinder of cork, *c*, which is ballasted underneath with a bit of lead, as shown. The needle is set afloat in this trough, the

water in which must present a slightly convex surface, and the cork must be pressed down so as to wet its sides. It will then take up a position in the centre of the trough, and if there be not a film of grease on the water's surface, the needle will turn absolutely without friction or torsion either. Mercury is useless as a substitute for water, because of the film from which its surface cannot be kept free. Even water is subject to a similar difficulty; but moderate care to avoid grease and dust getting about the float or dish, and the use of clean water, or, perhaps, better still, the employment of some liquid, such as turpentine or spirit, capable of dissolving grease, will prevent trouble from this source. The dish is placed upon a shelf arranged so as to bring the needle into the centre of galvanometer coils, and when the needle float is brought by the levelling screws exactly into the centre of the index circle, the slightest current will deflect the needle. Another advantage of the device is, that the slightest deflection can be observed, as the needle is almost perfectly "dead beat." I can do nothing with cocoon filaments; their perpetual dancing cloaks the movement due to faint currents. With the float, &c., as described, it is easy to shift the instrument about with moderate care; but the care required can easily be diminished if a caoutchouc tube, leading to the bottom of the dish, be fitted so as to be compressed or relaxed at will by a screw, thereby elevating or depressing the surface of the water."

Electricity in the Royal Navy.—It is understood that the troopship *Tamar*, Captain J. B. Warren, is shortly to be fitted with electric search and incandescent lights by the electrical staff at Devonport Dockyard. The necessity for this improvement has long been felt on board, and as the *Tamar* is the only large troopship which does not enjoy the advantage of electric illumination, Captain Warren, after his vessel had performed a successful voyage to China and back acquainted the Commander-in-Chief with this fact. Admiral Phillimore on referring to the dockyard authorities found that they were powerless to undertake the work unless directed to do so by the Admiralty. Subsequently an estimate for supplying the electric light was submitted to the Controller of the Navy, who returned an unfavourable reply. Since then, however, a change has taken place "aloft, and on the officials at Devonport, in answer to my lords," stating that there was ample room for the necessary apparatus, orders have been given for the work to be carried out.

Ball.—A few evenings since the annual ball in connection with Messrs. Blakey and Emmott's Cricket Club took place in the Mechanic's Hall, Halifax. An excellent full string band was in attendance, and there were about sixty couples present. It was intended to light the hall with the electric light, but as Messrs. Blakey and Emmott had been engaged to illuminate Col. Thoresley's residence, at Burnley, where Prince Albert Victor has been staying, the apparatus was not available, and the plan had thus to be abandoned. A most pleasant evening was spent.

NEW COMPANY REGISTERED.

George Forrest & Son, Limited.—Capital £50,000, in £5 shares. Object: To acquire the business of George Forrest & Son, brassfounders, and gas, water, electric light, mechanical and sanitary engineers; and to manufacture apparatus and contrivances for creating and supplying electricity, gas and other agencies for generating light and heat. Signatories (with one share each): Walter McNeil, 28, Devonshire Street, N.; Hy. George, 10, Nevill's House, New Street Square, E.C.; H. L. Lilley, Ware, Herts; W. H. Hardy, 5, Great Winchester Street; L. Hardy, 5, Great Winchester Street; A. W. Kerly, 14, Great Winchester Street; Henry Verden, 14, Great Winchester Street. The signatories are to appoint the first directors, and, in the interim, will themselves act as directors. Qualification: 20 shares. The remuneration of the board will be at the rate of £50 per annum for each director, and such further sum as may be voted by the company in general meeting. Registered 18th inst. by Messrs. Kerly, Son & Verden, 14, Great Winchester Street.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

F. H. Perry & Company, Limited.—An agreement, dated 5th ult., regulates the sale to this company of the business of Messrs. Perry & Cox, of 36, Victoria Street, Liverpool, opticians, scientific apparatus, manufacturers and electrical engineers. Part of the consideration is £400 in cash, and 320 fully paid shares of £5 each. As the residue of the consideration the company will deposit with the Bank of Liverpool a sum sufficient to discharge the debts and liabilities of the vendors in relation to the said business as specified in the second schedule of the agreement.

Medical Battery Company, Limited.—The annual return of this company, made up to the 15th inst., was filed on the 16th inst. The nominal capital is £100,000, divided into 20,000 shares of £5 each, the whole of which are taken up; 18,800 are considered as fully paid up. Upon 1,000 ordinary shares, £2 10s. per share has been called in two separate calls of £1 5s. each, and upon 200 shares the full amount has been called. The total paid up capital is £97,500, being £3,000 in excess of the amount recorded as paid up in the previous return.

Railway and Domestic Electric Lighting Company, Limited.—The annual return of this company was made up and filed on the 15th inst. The nominal capital is £6,000 in £10 shares, the whole of which are taken up; 360 shares are considered as fully paid, and £7 10s. per share has been called upon the remaining 240 shares. The calls paid amount to £1,644 15s. 10d., leaving £155 4s. 2d. unpaid. The paid up capital shows an increase of £444 15s. 10d. as compared with the previous return. Registered office, 6, Great St. Helens.

Kensington Court Electric Lighting Company, Limited.—The statutory return of this company, made up to the 12th inst., was filed on the 18th inst. The nominal capital is £10,000 in £5 shares, but the only shares at present taken up are the seven subscribed for by the signatories to the Memorandum and Articles of Association, and upon these nothing has yet been paid. Registered office, 11, Great George Street, Westminster.

Self-Winding and Synchronising Clock Company, Limited.—The statutory return of this company, made up to the 1st inst., was filed on the 5th inst. The nominal capital is £100,000 in £1 shares. The number of shares taken up is 20,917, and of these 15,000 are vendors' fully paid shares; the full amount has been called upon the remaining 5,917 shares. The total sum received in respect of calls is £5,464 5s., leaving £452 15s. unpaid. Registered office, 27 and 29, Leadenhall Buildings, Leadenhall Street, E.C.

CITY NOTES, REPORTS, MEETINGS, &c.

Direct Spanish Telegraph Company, Limited.

AN extraordinary general meeting of this company was held at Winchester House, Old Broad Street, on Tuesday, under the presidency of Sir James Anderson, for the purpose of considering the confirmation of the resolutions passed at the meeting on the 30th ult. for reducing the capital, in consequence of the abandonment of the company's original cable, from £190,000 to £95,000, the reduction to be effected by writing off £5 a share.

Mr. Charles Gerhardi, the manager, having read the notice convening the meeting,

The Chairman, before moving the confirmation of the resolution, announced that Mr. Bannatyne had intimated his intention of taking legal proceedings against the scheme being carried out, and that protests had also been received from holders of 37 shares. On the other hand, in favour of the proposal, the directors had received proxies from 90 shareholders. At the last meeting Mr. Baker was the only proprietor who, in the opinion of the board, presented any specific arguments which the directors could answer. Mr. Baker's remarks had a right to be seriously considered, on account of his knowledge of such schemes as that submitted by the directors. Mr. Baker said, Why not wait for 10 years, and then the preference shareholders would get the whole of the arrears, and begin with a 10 per cent. dividend after the 10 years? In his (the chairman's) opinion that argument had influenced some of the shareholders, but a little consideration would show them that at the end of 10 years the preference shareholders would get no arrears. The arrears lying by would naturally go to recoup the capital lost. If the capital remained intact, as it now was, at the end of 10 years the preference shareholders would get 7 per cent. only, and no arrears whatever, and the ordinary shareholders would of course get nothing. The latter would have to look forward to something like 40 years before they could get anything, unless the company paid off the debentures with the arrears. In that case the preference shareholders would begin to get some of their arrears, but still the ordinary shareholders could look forward to nothing. The position they were now in was this. Would they go on for 10 years and get nothing until that time, or would they now take 2 per cent. less than they would get then, and begin to receive a dividend now with £2 10s. per share of the arrears paid down? The directors had no possible object in doing anything but making the company a living concern. Another shareholder at the last

meeting also suggested the division between the preference and the ordinary shareholders of any dividend beyond 5 per cent. It was, however, to be remembered that in the past 13 years the ordinary shareholders, who found the bulk of the capital of the company, had received only 19s. 11d. per share in the way of dividend in that period. As for their getting above 5 per cent. in the time to come, that would depend upon what was going to happen in 10 years with the existing cables, and that was a matter which they could not foresee. They had £5,000 by way of reserve fund, but there was nothing whatever for war risks or contingencies other than the very ordinary contingencies for repairs, so that it might very well happen that at the end of 10 years the preference shareholders even would not get 7 per cent., while the ordinary shareholders would, of course, receive nothing. He did not know what Mr. Bannatyne's object could be in opposing them, but if it was with the idea of getting more than was now offered he thought the chances of doing so were very remote. He concluded by moving a resolution confirming the resolutions passed at the meeting on the 30th ult.

Mr. Etlinger seconded the motion.

Mr. Bannatyne said he had no object whatever in view beyond seeing that justice was done to the preference shareholders. He contended that the scheme proposed was both illegal and unjust, and he was more convinced than ever in that view. He differed altogether from Sir James Anderson's statement that there was no other way of improving the position, and he thought there might have been a conference between the directors and the leading ordinary and preference shareholders to see if some better plan could not be devised. In answer to the chairman, Mr. Bannatyne said he was not bound to mention any plan that he might have. The first matter was for the directors to withdraw their resolution.

The Chairman said that Mr. Bannatyne had spoken about justice and legality, but he would like to ask where was the justice or the legality of Mr. Bannatyne, when he was chairman, occupying that position and forming another company. Mr. Bannatyne, he asserted, had some other object in view.

Mr. Bannatyne repeated that he had no other object than that which he had mentioned.

A Shareholder, whose name did not transpire, objected to the scheme as being unfair to the preference shareholders, for it proposed to cut down the preference and ordinary shares in equal amounts, and, as the chairman had said, the ordinary shareholders had received scarcely any return.

Mr. Cochrane said that he should feel bound, notwithstanding what the chairman had said, to vote against the scheme. He thought that a more equitable proposition might be laid before them. It was to be remembered that the chairman was a director of the Eastern Company, who had a large interest in the ordinary shares. Those shares stood in the account of that company for £39,000. Sir James Anderson was also a director of the Globe Company. It was the ordinary shareholders' capital that had been lost, and the money obtained on the preference shares was for laying another cable, which was still in working order and earning money. That cable cost £45,000. He was aware that some of the preference capital was for "other purposes."

The Chairman, in reply, said that it seemed to have been forgotten by Mr. Cochrane that the preference and ordinary shareholders were partners in a business which had lost so much of its capital. That was the basis upon which the Board was going, and as he understood the law, there must be a *pro rata* suffering on the part of the proprietors in wiping off the capital or doing something to reinstate it. Mr. Cochrane had repeatedly attacked him because he (the chairman) was a director of the Eastern and the Globe Companies, but the holding of the Eastern Company in the Direct Spanish Company was all in ordinary shares, while that of the Globe Company was all in preference shares.

The resolution was then put to the meeting and declared carried by fourteen against five.

The Chairman, in answer to a remark by Mr. Burt, said that the Board would certainly be very glad to consider any scheme which Mr. Bannatyne might lay before them for effecting the object in view.

Mr. Bannatyne said that he knew of the directors' proposal only three days before the first meeting was held, when he returned to town. It was, however, pointed out, in answer to this remark, that the first meeting was held about three weeks ago.

Mr. Cochrane, after further discussion, moved, "That unless a tangible and practical scheme can be formulated in substitution for that of the directors, the shareholders deprecate an appeal to law as being expensive and useless."

Mr. W. Puckle seconded this motion, which was agreed to without any apparent dissent, Mr. Bannatyne having just previously left the room.

A vote of thanks to the chairman and directors terminated the proceedings.

The Eastern Extension Australasia and China Telegraph Company, Limited.

THE report of the directors for the half-year ended 30th June, states that the gross receipts, inclusive of Government subsidies, have amounted during that period to £224,843 0s. 1d., against £259,476 9s. for the corresponding half-year of 1885.

The working and other expenses, including £31,361 5s. 9d. for cost of repairs to cables and expenses of ships, absorb £81,775 7s. 1d. against £74,418 6s. 9d. for the corresponding half-year of 1885, leaving a balance of £143,067 13s. From this is deducted £3,992 7s. 4d. for income tax, and £41,595 for interest on debentures and contributions to sinking funds, leaving £97,480 5s. 8d. as the next profit for the half-year, against £140,358 6s. 11d. for the corresponding period of 1885.

One quarterly interim dividend of 1¼ per cent. amounting to £31,250, has been paid during the half-year, and another of like amount will be distributed on the 15th instant.

In consequence of the diminution of revenue, which is attributable to the causes referred to at the last general meeting, and which unfortunately still prevail, your directors do not feel justified in paying a bonus for the past half-year, and have therefore decided to carry forward the balance of £34,980 5s. 8d. to the next account.

In accordance with the provisions of the trust deed, dated 10th May, 1879, 251 Five per cent. Australian Government Subsidy Debentures were drawn on the 12th April last, for payment at par on the 1st July.

The renewal of the Penang-Singapore (original) Cable, referred to in the last report, was successfully completed on the 5th June last, and a considerable portion of the old line has been recovered. The cost of the operation will be dealt with in the accounts for the current half-year.

There have been numerous repairs to the company's cables during the past half-year, but no serious interruptions occurred during that period. Unfortunately, since the close of the half-year, both the Madras-Penang and Rangoon-Penang cables have been simultaneously broken, which totally interrupted the communication between India and this company's system for 13 days, and resulted in considerable loss of traffic. Notwithstanding the prevalence of the south-west monsoon, the company's maintenance steamers have been successful in repairing both sections. All the company's cables are now in good working order.

The land line between Port Darwin and Adelaide, belonging to the South Australian Government has, as usual, been well maintained during the half-year under review.

Anglo-American Telegraph Company, Limited.—The directors have resolved that the balance of the revenue account for the quarter ending September 30th, amounting to £16,500, be placed to the credit of the renewal fund.

Direct United States Cable Company, Limited.—An interim dividend of 2s. per share, being at the rate of 2 per cent. per annum, has been declared for the quarter ended September 30th last, payable on the 30th inst.

TRAFFIC RECEIPTS.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 15th October, are £1,816, as compared with £1,998 in the corresponding period of 1885.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 15th were £3,215 after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

NEW PATENTS—1886.

13058. "Applying electric motors to vehicles." M. IMMISCH. Dated October 13.

13080. "Material for the production of an exciting and depolarising battery fluid." W. C. GOLDNER. Dated October 13.

13111. "Electric lamps." W. WARD. Dated October 14.

13121. "Machine for automatically giving an electric shock upon the insertion therein of a particular coin." W. B. AVERY. Dated October 14.

13126. "Reflectors for portable electric incandescent lamps." J. G. LORRAIN, S. WATERS. Dated October 14.

13142. "Electric indicator for electric bells, &c." E. O. EATON, S. F. HUXLEY, J. T. MAYFIELD, J. T. TODMAN. Dated October 15.

13186. "Combining steam engines with dynamo-electric and other machines driven directly by them." P. W. WILLANS. Dated October 15.

13208. "Electricity meter." E. T. CARTER. Dated October 16.

13293. "Transmitting rotary motion from motors to dynamo-electric machines." S. ALLEY, A. G. BROWN. Dated October 19.

13312. "Printing telegraphs." J. H. LINVILLE. Dated October 19. (*Complete.*)

13340. "Tubes or conduits for laying underground electric conductors, and insulating coverings for electric conductors." H. E. NEWTON. (Communicated by E. D. McCracken.) Dated October 19. (*Complete.*)

13341. "Machines for covering and insulating electric wires." H. E. NEWTON. (Communicated by E. D. McCracken.) Dated October 19. (*Complete.*)

13366. "Transmitting motion to the armature of dynamo." J. R. H. WILLIAMSON. Dated October 20.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1885.

12288. "Improvements in secondary batteries, accumulators, or magazines of electricity." H. THAME and J. R. THAME. Dated October 15. 8d. The inventors form the lead for the elements of the improved accumulators of tubes, or cylinders, of that metal set in series, by which means the inventors are enabled to overcome the tendency to warp, or bend, or lose their proper form which such elements when formed of lead in the manner heretofore practiced have developed in use.

12360. "Improved means for use in telegraphing addresses in cities and towns." A. FEATHERSTONHAUGH. Dated October 16. 6d. The inventor designates each street, road, or the like, in a city or town by a distinguishing number, and he provides a book in which the numbers are printed in chronological order, with the streets, roads, or the like, which they denote opposite to each, and there may also be added an alphabetical list of the streets, roads, or the like, with their denoting numbers, and to further facilitate the telegraphing of the addresses the distinguishing number may be marked at each street, road, or the like, together with its name.

12623. "Improvements in telegraph posts." S. SHARROCK, and F. G. SHARROCK. Dated October 21. 8d. Relates to improvements on telegraph posts, such as are described in the specification of a patent granted to Samuel Sharrock, No. 2089, in the year 1871. The upper part of the structure consists of a taper tube of sheet steel or wrought iron made in lengths, and in each length the rivetted joint, in place of being straight as heretofore is made to pass helically around the tube. Thus the strength is equalised all round, and in manufacture it is found easier to make the tubes straight than it is at present, as the hammering in closing the rivets is no longer all on one side. The claims are 4 in number.

12915. "Improvements in electric contact makers and breakers." J. T. BUCKNILL. Dated October 27. 8d. Consists of a steel or other elastic ring, preferably circular for most purposes, but it may be elliptical or of other form. This ring is fitted either internally or externally with contact points, which are insulated from the ring and from each other; and other points may or may not be added on suitable supports, and situated either inside or outside the ring.

CORRESPONDENCE.

The Electric Locomotive and Power Company, Limited.

Although I hope I may yet be spared the necessity of causing retardation of electric traction work any where along the line, the prospectus of the Electric Locomotive and Power Company, Limited, compels me not to remain quiescent.

The *advantages* claimed for Mr. Elieson's patent by many Press notices, are fully described in my patent of January 31st, 1883, and numbered 539 and 539*.

Mr. Elieson's patent is dated nearly a year and a half later than mine, viz, June 6th, 1884, and numbered 8,654.

I, however, do not wish the electrical world to think that I give the motor a movement of running round a table, as I should know very well that the *additional* power required for that purpose would be pure and unnecessary loss; enough to make all the difference probably in many cases of the possibility of competing with other methods of traction.

I have had to give formal notice, through my solicitors, to the Electric Locomotive and Power Company, Limited, that Mr. Elieson's patent infringes mine.

The electric field is large enough for us all; one man develops one point, one another.

Radcliffe Ward.

10A, Great Queen Street, Westminster, S.W.,
October 20th, 1886.

The Marchant Engine.

I notice in your editorial column of the 8th October the remark that a writer in *Industries*, "whilst affecting to disbelieve the economy of coal, &c." Allow me to say that there is no question of affecting to disbelieve, but that the economy claimed is downright impossible.

If I were told that a certain turbine, or other hydraulic motor, yielded an efficiency of over 100 per cent., it would not require any profound knowledge on my part to be quite certain that my informant was—to take the most charitable view—labouring under a delusion; and the case of the Marchant engine is perfectly analogous.

From the steam pressures and temperatures between which the Marchant engine works, the very best result that could be obtained with an ideally perfect engine can easily be calculated by a formula, the correctness of which is quite beyond dispute; this is the well-known expression for the efficiency of a perfect heat engine $\frac{T_1 - T_2}{T_1}$, where T_1 and T_2 are respectively the highest and lowest absolute temperatures occurring in the substance by which the motor is worked.

Before applying this formula to the case under consideration, I may remark that it is too often forgotten that under *no possible conditions*, even with an *ideal* engine, can the whole of the heat communicated to the working fluid be utilised; a certain proportion *must* be rejected, and what that proportion is depends entirely on the limits of temperature between which the engine works.

The Marchant engine works with a boiler pressure of about 275 lbs. per square inch; I will assume that there is no loss between boiler and engine, and that this therefore also represents the initial pressure in the cylinders. The temperature corresponding to a pressure of 275 lbs. is about 414·2° Fahr., say, 415°, hence absolute temperature = 415° + 460° = 875°.

That portion of the steam to which Mr. Marchant applies his process does not work in connection with a condenser and therefore can at the best only be advantageously expanded down to atmospheric pressure; assuming this to be the case, the lower limit of temperature is 212° Fahr., or 672° absolute; if now we substitute these values in the formula given, we have for the maximum theoretical efficiency:

$$\frac{T_1 - T_2}{T_1} = \frac{875 - 672}{875} = 0{\cdot}232, \text{ or}$$

23·2 per cent. The heat developed by the combustion of 1 lb. of coal is (according to D. K. Clarke's tables) equivalent to 10,171,576 foot lbs.; in a very good boiler 80 per cent. of this may be utilised in producing steam, say 8,137,261 foot lbs., and this, under the most favourable conditions, is the heat-equivalent at the disposal of the engine; of this quantity a perfect engine will only utilise 23·2 per cent., or 1,887,844·5 foot lbs.

One horse-power exerted for an hour is equal to 33,000 × 60 = 1,980,000 foot lbs., hence to develop this amount of work the fuel required will be $\frac{1,980,000}{1,887,844{\cdot}5} = 1{\cdot}048$ lbs.

That is, assuming Mr. Marchant's process to be carried out in its most perfect form, with no losses by radiation or conduction or any other cause, the lowest consumption of coal possible would be about 1·048 lbs. per I.H.P.

If the expansion were continued down to $\frac{1}{10}$ atmosphere absolute, the ideal coal consumption would be 0·67 lb. per I.H.P.

Mr. Marchant claims no unusual efficiency for his boiler, and with the large number of cylinders of one kind or another used in his engine, the losses by radiation and conduction must be considerable; the process, moreover, is *not* perfect and is only applied to a portion (two-thirds) of the steam, and yet, in spite of this, the engine is said to use less coal *per brake horse-power* than an ideal engine under the same conditions would consume per indicated horse-power. Apologising for occupying so much of your valuable space, I am

The Writer of the Article.

I enclose herewith a copy of my letter to Mr. Voss and of his reply, in regard to the vexed question of whether I had called on Mr. Massey or not.

I hope it is unnecessary for me to say that for the reasons stated to Mr. Voss, together with the lapse of time, I had no recollection of this gentleman's name or of my having seen him.

I send these copies for your information or for publication as you may think fit.

R. M. Marchant.

25, Canonbury Villas, N.,
October 19*th*, 1886.

[COPY.]

25, Canonbury Villas, N.,
October 16*th*, 1886.

J. VOSS, Esq.,

MY DEAR SIR,—Some years ago in your agency for my engine you frequently took me to engineers you thought capable of advancing it. I have seen so many with you that I may be excused for saying that I have no recollection after the lapse of time of individuals or places.

Some weeks ago a Mr. Massey, an electrical engineer, published a letter stating that he had spent the best part of an afternoon listening to my "solemn foolery" —without examination or enquiry he contests the position taken up by examining engineers.

At the request of the Editors of the ELECTRICAL REVIEW I am answering this letter and another, in their next issue.

I shall be obliged by a letter from you stating your recollection of any such interview, if it occurred, as I now suppose in some minor degree to that stated, it must have done.

Please not to delay your reply.

Yours truly,
R. M. MARCHANT.

P.S.—July 25th, 1882, 47, Cannon Street, is the stated date and place of the interview.

R. M. M.

To the above letter Mr. Voss replies as follows (his letter is at your service) :—

[COPY.]

69, Fenchurch Street,
October 18*th*, 1886.

To Mr. R. M. MARCHANT,

DEAR SIR,—In reference to your letter of October 16th, you did call with me on Mr. Massey at my suggestion and in regard to electric lighting.

We were there about half an hour, and I have no recollection of any advice given otherwise than of seeing Mr. Macfarlan Gray on the subject.

Yours faithfully,
J. VOSS.

You are kind enough to afford me the opportunity of replying to your correspondents writing in your issue of 15th October in regard to the "Marchant engine."

I desire, in the first place, to deal with Mr. Massey's further letter in that issue on the subject.

Of this letter—

Item 1. Expresses Mr. Massey's thought that my engine would come in a bad second ; and for such mere thought I need only say I am not in any way responsible, and it stands for what such thought so formed and expressed is worth ; indeed, I should be sorry to express such thought on any matter I knew so little of, lest it should be *mistaken for venom.*

Item 2. Informs us that he is "*dying* to see the cards taken from the pump which supplies the steam feed," and I can only regret that he did not take the opportunity offered to all comers to examine these at the Inventions Exhibition, where they were hung up in a frame, as in such case he might have lived the longer.

Item 3. Mr. Howard having *inquired* first, and expressed *his opinion* afterwards, is, I submit, the more competent engineer of the two to express his opinion, and as I deal with the brake at the end of my letter, I need not further refer to it here.

Item 4. Offers "to wager a small amount," and it is probably in regard to inquiries for making such wager, that I had to write the following letter :—

Letter referred to in regard to an offer to examine the engine—

"11th October, 1886.

"Messrs. Fraser and Fraser.

"Dear Sirs,—In regard to my conversation with your Mr. John H. Fraser on Mr. Massey's offer through you. This gentleman appears fond of print, and I think it better to write you my answer. I have no recollection of Mr. Massey, and to my knowledge never consulted him on any matter. This gentleman's communication to the ELECTRICAL REVIEW of 1st October appears to me an uncalled for and an unprofessional prejudgment of an invention which he had not taken the trouble to see. I am the inventor so attacked, and as the oldest engineer of the two, am old-fashioned enough not to believe in any man who strikes first and enquires afterwards. For these reasons I decline the gentleman's offer. Yours faithfully,

R. M. MARCHANT"

And in regard to "the *weak* points of this new thing," the question would appear to be to understand the *strong point* which puts the steam back into the boiler without pumping it back, which no one knows better than I do *cannot be done.*

Item. 5. In regard to the italicised quotation I can only congratulate Mr. Massey on either his memory or his invention, and refer, in answer to this, to my explanations of the process to engineers who in *other men's* estimation are at least as capable of forming an opinion as Mr. Massey, and who have accepted my theory as to the result obtained.

As to my want of recollection of meeting Mr. Massey, I have written Mr. Voss to whom that gentleman refers, as it may be possible that Mr. Voss may have been so impressed by *whom* he saw, and by *what* he heard, as to remember an interview in regard to which, I may be excused for saying, that at this distance of time I have no recollection.

So far as there is serious matter in what Mr. Massey has written, he would appear to appreciate no difference between a *steam* feed and a *water* feed, even if the former could be obtained by some means unknown to that gentleman.

In regard to the questions asked by the gentleman signing himself "Twister," items 1 and 2 would appear to require some explanation ! In item 1 we find the indicated or calculated horse-power written of as the same thing. In item 2 we are asked whether the indicated horse-power will equal the calculated.

I confine my answer, therefore, to the question between indicated and brake power.

Where the apertures for supplying steam to the indicators do not throttle the steam, and where the springs are correct, and the indicator pistons are not reduced to render the springs applicable for higher pressures than they will otherwise bear, the indicated power ought to be in excess of any other record of power.

But engineers have recorded cases where the indicated power has been less than the brake power through imperfection of application, and I refer to trials at former agricultural show meetings where the most careful tests have been made by eminent engineers of competing engines, and where in one case at least the prize winner only succeeded because of the brake application, and would have been behind on the indicated results.

The error arising from any imperfection in the application of ordinary indicators to high pressures, and from the introduction of a fractional sized piston, is liable to great increase beyond any low pressure error, and whilst the action of the steam is shown to the benefit of the enquirer, the power shown may be very incorrect.

Item 3. "Twister" is wrong in his dimensions. Item 4. Whether this were the case or not would depend on the pressure and application of the steam, both in the cylinder and beyond it.

Surely "Twister" can scarcely be an engineer to ask such a question and assume such a result; or if he be one, *he had better remember his letters!*

Engineers are generally aware that in the old days of cylinders supplied with steam *throughout* the stroke of the piston, the consumption of coal was from some 10 pounds of coal and upwards per horse-power per hour; they are also aware that economy *commenced* with the expansive use of steam, and that by *its expansion* engines supplied from boilers all of which are *still water fed*, have now reduced their consumption to two pounds of coal per horse-power per hour.

Such difference of coal consumption would appear to practically express the benefit derivable from the expansive action of steam which follows on each full supply charge, and would appear to show that "Twister" has made on this assumption (*on which he bases all his calculations and questions of item* 5, *which he introduces as a follower*, with the words, "now comes the most important question of all"), the small mistake of putting 1 for the expansive benefit instead of putting 5 for it.

Some twelve months ago the *Echo* published the statistics of the ascertained coal consumption of non-expansive engines in Birmingham, and I remember that the consumption was much above the 10 lbs. at which I put it.

With such effect from the expansive use of steam, it is evident that there must be a larger proportional saving by the use of the *steam* feed to the boiler, which I accomplish with actually less work than that required for the ordinary *water* feed. Item 5 being based on the very erroneous assumption of item 4, and being answered in items 1 and 2, I need only say that it appears very difficult to understand why "Twister" should intimate that (of all men) our very ancient friend "*Euclid*" has to do with the matter! *Why not "Galileo?"*

"In conclusion"—the brake is used in precisely the manner that all clip brakes are used, the clip is put on after the engine starts, and is increased or decreased as required to give the pull worked to on the Salter's spring balance. The vertical lever was adopted instead of a horizontal and balanced lever lifting a load (over and above such balance of the lever itself) for convenience of space only.

It seems difficult to understand why that which is the pull on the vertical lever would not equally be the load or pull on the horizontal lever alluded to, or why the two applications should be regarded differently; in each case the greater load necessitates a stronger clip to the purpose of lifting it, as is the case with the "Prony" brake; and, with the exception of the vertical lever instead of a horizontal one, the brake now used is of the same general construction as one I used some years ago, with the approval of competent engineers, in my earlier and experimental trials in Hatton Garden, the results with which brake closely corresponded with those which had been obtained with the Royal Agricultural Society's brake, which had been previously lent me for a limited period.

I am greatly obliged by your suggestion of gentlemen of high standing for conclusive trials, which suggestion was at once agreed to by the managing-director of our syndicate, and I will shortly communicate with these gentlemen on the subject, and with you in regard to a further inspection on your part which you are kind enough to offer.

R. M. Marchant.

Will you kindly review your tabulated statements of the results of your trials of the Marchant Engine, as published in the issue of 17th September last, and explain the following anomalous cases.

The first table gives the boiler pressure at commencement of trial as 262 lbs. and at finish as 249 lbs. Notwithstanding this decrease of pressure, the effective horse-power went up from 100 to 110·5. Table second shows a decrease of boiler pressure from 262 lbs. to 200, yet effective horse-power went up from 100·5 to 101·6. Similar results are seen on Tables 3 and 4. You say the indicator cards bore out the readings from the dynamometer. If so they must have shown an increase of area as the boiler pressure diminished. So far as I can see, this could only occur by variation in the cut off, which, from your description, does not appear to have been altered. Why were not the indicator cards produced side by side with your description? It seems an unaccountable condition to find the working capacity of any engine, or, indeed, any working agent, increasing with a diminution of the supplied energy.

On the other hand the steam pressure should not be allowed to get lower during trials. When this is the case it shows that the fires were lowering, and that towards the termination of trials the fires were becoming exhausted. This would not, however, tell so badly on the accuracy of the results if the calculated horse-power showed a proportionate decrease. When this was not the case, I feel confident that most of your readers will have concluded that there must have been a flaw somewhere.

That flaw is, as Mr. Massey has already pointed, due to the dynamometer. It was pointed out by you that this form of dynamometer was devised by Mr. Marchant so that the heavy weight of 720 lbs. could be taken off the shaft of the engine when not running. Surely Mr. Marchant must know very well that the resultant of the two strains due to the weight and tension of balance (while working) is a far more serious one to the stability and safety of the shaft than one of them can be while the engine is standing idle.

You say "The fly nut, n, is only partially tightened up, the grip when required being effected by the opposite nut, n^1." See your own diagram. This, in my opinion was a fatal error, for when tightening the nut, n^1, you were compressing the block, B^1, and consequently pulling the lever, L, and with it the balance spring, the pieces, F and E, preventing the brake from riding easy on the fly-wheel. This, then, accounts for the abnormal condition I have pointed out above. Although the energy of the steam and likewise that of the engine were beyond question decreasing, the brake, by simply screwing up the nut, n^1, continued to show a decided increase.

Your insertion of the above, with explanations, will oblige

James Fraser.

21, Keppel Street,
Russell Square, W.C.

[We willingly insert the above letter. Mr. Fraser has misunderstood our remarks respecting the indicator diagrams, as we personally did not take any. His remarks in regard to the variations of the tabulated power and pressures are based on the erroneous assumption that the starting or throttle valve was kept at one uniform set during the trials, whereas its operation was left to the engine driver, who regulated its opening as he considered it desirable for the higher or lower pressures, or as appeared necessary to provide for an occasional drag in the satisfactory maintenance of the air spring, which is referred to in the tables. In regard to the lower stream pressures, Mr. Fraser will observe the recorded and varied objects of the trials; these were, as stated, to test the performance of the engine in regard to a stated and carefully observed consumption of coal, and under the varied conditions stated in the report we published in our issue of September 17th. Mr. Marchant's letter gives his explanation of the brake; and the letter of Mr. Howard in our issue of October 8th, confirms our opinion that the percentage of error which may possibly occur by the use of this brake is not very high.—EDS. ELEC. REV.]

Some weeks ago I had the privilege of joining you in witnessing a trial of the Marchant engine. It was to be a brake test for work against a measured consump-

tion of fuel; we were, therefore, quite independent of any considerations of dimensions of cylinders, indicated horse-power, steam pressure, and weight of water evaporated.

The results witnessed by us are truthfully set forth in your report of September 17th along with other material facts not ascertainable by our inspection, but which were given by Mr. Marchant and the gentlemen associated with him, who answered all our questions regarding matters of fact frankly and honestly.

Certain doubts as to the reliability of the brake which were raised by Mr. Massey and by "Twister" in your correspondence columns, were also suggested to me at the time of the trials. Neither of these can be entertained if the statement of facts made to us by Mr. Marchant in answer to our questions are trustworthy. You have given an illustration of the brake frame, and you have described its construction as disclosed to us by Mr. Marchant, giving full reasons as to the object of this particular construction, so that your readers have had that, which we could not perfectly inspect, upon the same authority as we had it. Mr. Massey, and evidently also the writer in the *Machinery Market*, conceive that the brake frame had its fulcrum at the roller block, E. Now, Mr. Marchant assured us that the frame is quite clear of E when the brake is in operation. Our inspection, so far as this part could be seen, corroborated this statement. The action of a fulcrum at E would, however, be quite contrary to the contention of your correspondents; the upper frame of the brake is rigidly connected to the hollowed friction block, thus rendering it certain that the motion of the brake lever will be concentric with the flywheel. Any anchorage at E would, therefore, be so much pull *taken off* the record.

"Twister's" question about tightening up the nut, n', farthest from the Salter's balance was also considered by me at the trial. It will not signify *how* the grip is produced if the brake frame be free from anchorage and from abutment except at the Salter's balance. If the tightening of n' could put a pressure on F whilst the brake is in operation, then would the whole of the testing be fallacious. To negative the possibility of this we have Mr. Marchant's positive assurance that while *in operation* the brake frame is quite clear of the stop, F. During the tests I tried to tighten up the other nut, n, the one nearest the spring balance, but found that the bolt turned round with the nut. I objected to this at the time on the same ground which I am now discussing, and notwithstanding the positive statements regarding the stop, F, I suggested that you should state in the report that "the fly nut, n, is only partially tightened up," &c. The object of my doing so was obvious; during the trial the flywheel pit was filled with water to absorb the heat caused by the friction of the brake, and consequently the points E and F were hidden from view, and had to be described as they were described to us.

It would be ungracious of me to question the veracity of Messrs. Marchant, Downie, and Fraser Bros.; they must all know how F and E are in relation to the brake when it is in operation, and I am bound therefore to accept what they assert to be true regarding it. This is not a matter about which they may be merely mistaken in judgment, it is a matter of fact which they must know, and if the brake frame is not clear of F when in operation then they misled us. I did not go to the trial as a detective; I went there as one interested in the progess of practical science; we recorded what we saw and you have faithfully reproduced our figures as well as the statements made on the authority of Mr. Marchant and his colleagues.

I regret that Mr. Massey's letter has not been answered sooner by me. On the Feast of St. Cyprian this year I unfortunately contracted a severe cold, and since the 3rd inst. I have been confined to my bed. I am now getting on my feet again, although still confined to my room. Directly I get out I shall offer my services to Mr. Marchant to personally inspect the points F and E, avoiding "FEE," and hope to add my testimony to his that the brake frame is free when in operation, and also ascertain from the indicator diagrams of *seven* cylinders that the brake tests may be relied upon.

A. Reckenzaun.

October 19th, 1886.

The Distribution of Power.

It appears to me that the scheme of power distribution by compressed air at Birmingham ought to attract the attention of electricians.

This scheme of distributing 15,000 H.P. from a central station, seems to show that the importance and utility of distributing power from central stations, are now recognised facts; but it remains to see which is the best way of doing it, and if electricity would not suit the purpose better than compressed air. I beg to submit some figures taken from an article published in the *Génie Civil* for 25th September.

The calculations are made in supposing a transmission of 100 H.P., the consumption of the steam engine being 1·700 kilog. of coals per hour and per horse (price 0·12, or about one penny).

Cost of One Distributed Horse-power.

Distance of transmission in meters	100	500	1,000	5,000	10,000	20,000
Electric system ...	0·187	0·192	0·202	0·236	0·296	0·480
Compressed air system	0·330	0·336	0·347	0·422	0·547	0·666

Perhaps, in the interest of this branch of electricity, you will kindly allow a further and exhaustive study of the question to take place in your columns.

H Serrin.

Incandescent Lamp Patents.

The attention of our clients, Messrs. Crossley and Hicks, has been called to a statement in your issue of the 15th inst. by Mr. Arthur Shippey in relation to their specification, No. 13,201, of 1885 (abstract of which appeared in your issue of the 1st inst.), which relates to "Improvements in Incandescent Lamps," in which statement Mr. Arthur Shippey is alleged to say that he had previously obtained patents for the same purposes, and that our clients' specification, No. 13,201, of 1885, is anticipated by his patent, No. 5,955, of 1883. Now, on behalf of our clients, Messrs. Crossley and Hicks, we have to request you to insert in your next issue our clients unqualified contradiction of any such statement. Our clients being advised that such statements are not true in fact, are prepared to guarantee any users of their patented lamps against any claims that Messrs. Shippey or any one else may make upon them.

James & James.

23, Ely Place, E.C.,
October 20th, 1886.

Secondary Batteries.

In the article upon M. Julien's electrical tramcar which appears in your last issue, it is mentioned as a novel point that the accumulators employed "are formed of a special alloy of lead and antimony which renders them impervious to the action of the current and greatly increases their solidity and prolongs their duration."

I would point out that in one of my very early patents, No. 3,987, September, 1881, I describe the use of such alloy "for the purpose of giving increased durability and hardness, and I claim "the use in secondary batteries of plates, elements or supports composed of alloys of lead and antimony for the purposes set forth."

John S. Sellon.

The Hall, Sydenham, S.E.,
October 16th, 1886.

Submarine Cables.

Would any of your readers kindly enlighten me upon the following subjects?

1. What is the cause of the unpleasant odour that arises from cables after having been taken on board ship and submerged in clean water, that has previously been stowed in shore tanks for many months without the water being changed, and does this foul water in any way injure the tape on cable?

2. What causes the vapour from such cable to tarnish all brass and paint work it comes in contact with, also is this vapour wholesome?

It is, of course, understood that in the above case the cable is under water.

H. G. G. S.

[The unpleasant odour is probably due to the "clean water" becoming more or less foul by contamination with the cable, which is said to have been immersed in foul water for many months. Was this, by the way, in a hot climate? The tape is more likely to be injured by foul water than by pure. Vapour from foul water can scarcely be considered very wholesome, and we should expect brass and paint work to tarnish quicker in such a vapour than in a pure atmosphere.—EDS. ELEC. REV.]

Incandescent Lamp Monopoly.

I trust you will kindly allow me to say a few words with regard to the resolution proposed by Mr. Swinburne and seconded by myself, and which, I am pleased to say, was carried unanimously, to the effect that in the interest of the whole electric lighting industry a committee is to be appointed to consider what steps had best be taken to prevent, if possible, the threatened monopoly in incandescent lamps.

A proposal was made at the meeting that a few large companies should combine to subscribe the amount necessary to carry on the Appeal. In my opinion this matter, which in reality affects every member of the trade, ought to be made the occasion of a union of the whole electrical community. A matter of such importance, and which, if the present decision is not reversed, will have such a very depressing effect on the advancement of electric lighting, already hampered in a great measure by the Electric Lighting Act, and which affects almost every individual connected with the industry, should not be made the subject of a combination amongst two or three companies who would have no consideration for the the interests or welfare of the many.

To the many, as Mr. Swinburne justly remarked, is due the credit of making the incandescent lamp of to-day the wonderful improvement it is upon the lamp as first put on the market by Edison.

Surely there can be no obstacle in the way of raising the required sum of £2,500 amongst such a numerous class as those connected with or interested in this industry, and I trust that everyone will do their best to assist Messrs. Woodhouse and Rawson; and I am confident that the increased business which will be done as soon as this unsettled state of affairs is changed, will amply repay any subscription that may be forwarded; and in conclusion, I hope that this meeting will have opened the eyes of electric lighting engineers sufficiently to show them how necessary it is to have some sort of a union amongst themselves and that this will be the basis of the formation of an Electric Lighting Engineers' Protection Society.

Lawrence Oppermann,
per C. O.

39½, Leather Lane, Holborn,
October 16*th*, 1886.

The Patent Office and New Patents.

Mr. A. Shippey is mistaken if he supposes that it is the duty of the Patent Office examiners to examine into and report upon the validity of patents applied for prior to acceptance of the final fee. The function of the examiners is chiefly to ascertain that the papers are prepared in the proper manner, and, broadly stated, does not extend to any investigation of the novelty of the inventions, nor to the question whether they, abstractedly considered, form proper subject matter for patents, which question (as I was the first to point out) in most cases is merged in that of novelty.

The fault is not in the adminstration of the law, but in the law itself. At the time when the several bills which led up to the existing Patent Acts were under discussion, I persistently urged, through your columns, that a thorough investigation into the validity of a proposed patent should be made before the patent was granted, so that the patentee might receive full value for his money, but the opposition to the proposal to subject every patent application to such a scrutiny was so great that the Bill was allowed to pass in its present emasculated form.

I ought to add, however, that when an application for a patent is lodged, the examiners are required to see that there is no confliction with any unsealed applications which may be in the Patent Office at the same time. I am sorry, however, to be compelled to state, that I have proved by experience lately that on this point their practice is sometimes rather lax, although I must at the same time testify to the admirable manner in which, as a rule, they discharge the duties which devolve upon them.

Thos. J. Handford.

50, Bedford Row, E.C.
October 18*th*, 1886.

A New Scale for Tangent Galvanometers.

On account of the correspondence which has recently taken place in this and other journals regarding the use of the tangent scale in a galvanometer when the plane of the coil makes an angle with the direction of the force in the magnetic field, the following extract from Sir William Thomson's patent, No. 4,617, of 1883, and the accompanying remarks, may clear up some of the points that have been raised:—

"In using this instrument I sometimes cause the zero to be at one end of the scale, so that when the potential is at the prescribed definite amount the pointer is at the centre mark of the scale of tangents. The deflections are thus more easily observed on account of the large size of the divisions."

This extract is quite explicit as to taking the zero at one end of the scale, and it is abundantly evident from the text of the patent, and from the illustrative drawings, that the scale referred to is a tangent scale. The essential feature in this use of the tangent scale is that the strength of the current is proportional to the difference between the tangents of the angle corresponding to zero and that corresponding to the deflection due to the current.

The total length of the scale, as shown in the patent already referred to, and used in this laboratory for over two years, is 120°. Lately, however, the length of the scale has with considerable advantage been increased to 147·8°; thus giving twice the sensibility obtainable with the 120° scales.

As regards Prof. Carey Foster's letter to *Nature* of October 7th, 1886, a tangent galvanometer arranged to use the tangent scale in this manner is essentially adapted to measure currents which flow through its own coil in one direction only; but in these instruments, as designed by Sir William Thomson, the necessary accuracy is secured by the following procedure. The index (which has a range of about 95° on each side the middle point of the tangent scale), is caused to point to a mark exactly 90° from the middle point of the scale, and the relative positions of the coil and the scale are then adjusted, so that when the index points to the 90° mark, the strongest current which can be safely sent through the coil produces no sensible deflection.

J. Rennie.

Physical Laboratory, the University
Glasgow, *October* 18*th*, 1886.